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PUBLIC LAND POLICY AND THE ENVIRONMENT. VOLUME 2. PART II: ENVIRONMENTAL PROBLEMS ON THE PUBLIC LANDS. SUMMARY STATEMENT AND CASE STUDIES 1 THROUGH 8

Roger P. Hansen, et al

Rocky Mountain Center on Environment
Denver, Colorado

December 1970

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PUBLIC LAND POLICY AND THE ENVIRONMENT

Part II

Environmental Problems on the Public Lands

Summary Statement &
Case Studies 1 through 8

A Study Prepared for the
Public Land Law Review Commission

by

the Rocky Mountain Center on Environment
Denver, Colorado

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Part II (Vol.2) of the study contains 8 case studies, each of which discusses land uses or management practices on public lands having environmental consequences and an initial summary chapter which draws together the overall implications of these studies and those contained in Vol. 3 (Part II cont'd) of the report.

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STUDY OF ENVIRONMENTAL PROBLEMS
ON THE PUBLIC LANDS

CASE STUDIES SUMMARY

Details of illustrations in
this document may be better
studied on microfiche

by the

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Case Studies Summary

STUDY OF ENVIRONMENTAL PROBLEMS ON THE PUBLIC LANDS

Introduction

The contract for "A Study of Environmental Problems on the Public Lands" was entered into on November 21, 1969, following almost a year of design study analysis by the Public Land Law Review Commission staff. The study design was structured to identify those public land management practices that have caused either serious or inconsequential ecological disruptions, as well as those practices that might best maintain stable, viable ecosystems (a balanced arrangement of plants and animals). The study was not designed, as some originally suspected, to advocate total preservation of all natural resources from human use; it was designed to determine how a variety of uses could be accomplished while maintaining the vital life support system on the public lands.

Some users of the public lands felt, and may still feel, that an environmental study is irrelevant in terms of "real" public land problems. However, the current national concern for environment quality, finding new expression at the highest levels of government, suggests that there is now an environmental imperative in public land policy, as there has always been an economic imperative.

The objectives of the case study analysis were: "(1) to provide the Public Land Law Review Commission with information needed to evaluate the adequacy and effectiveness of present laws, regulations, policies, procedures and practices relating to the consideration of environmental and ecological factors in public land policies and decisions; and (2) to examine various alternative courses of action that are or could be available to protect or enhance various environmental values and resources."

Approximately 130 candidate case studies were reviewed with 17 finally selected for analysis. The public land uses represented include multiple use, grazing, mining, wildlife habitat preservation, timber harvesting, power development, utility rights-of-way, highway construction and outdoor recreation. The environmental enhancement or degradation discussed in the case studies has either occurred or is anticipated. Types of environmental impacts include air quality, water quality, and alterations of scenic, wilderness, wildlife, fishery and outdoor recreation values. The intent of the case study analysis has been to examine past policies, procedures and practices with a view toward determining future courses of action which might be appropriate to protect the environment; it has not been to attach "blame" or condemn various agencies or organizations.

The "Case Study Design Requirements" (Appendix S-1) imposed upon all the consultants some standard of comment and point of view. It stated:

> These case studies must be objective and scientifically valid. Attempts to "propagandize" a point of view or to make sweeping generalizations from one or two examples must be avoided. However, it must be recognized that value judgments . . . are as necessary as they are unavoidable. This study will make certain value judgments on resources sometimes considered incapable of measurement in traditional economic terms. Individuals making the case reports may assume that maintenance of a quality environment for man is an acceptable objective of public land policy.

The Case Study Model utilized by most of the consultants followed this general format: recitation of the facts; discussion of environmental impact; consideration of problem origins; and environmental considerations and alternatives. There was not time nor funds available for any original research in the case studies, which were confined to analysis, evaluation and review of existing data. Some case study consultants had done previous research on the same subject matter and these data are considered.

ROMCOE is grateful for the dedication and quality of performance of the case study consultants and their associates who performed this Study under less than ideal conditions. Even though many of them initially termed the two-month study deadline schedule "impossible," they deemed the study significant enough to rate their top priority. Dedication and initiative compensated for lack of time.

I. Types of Environmental Problems and Impacts

While a variety of ecological considerations and environmental impacts run through the 17 case studies, some occur more frequently than others. (Table I). All of the case studies provide instructive vignettes on ecological changes generated by land management activities

TABLE I

ENVIRONMENTAL IMPACT CONCERNS COMMON TO THE CASE STUDIES

	AIR POLLUTION	WATER POLLUTION	NOISE POLLUTION	LITTER	WILDERNESS	WILDLIFE	AESTHETICS	RECREATION QUALITY	FISHERY	EROSION
tholith Granitic		*			*	*	*	*	*	*
ke Tahoe		*				*	*	*	*	*
nderson Project	*	*		*		*	*	*	*	*
irley Basin	*	*				*	*		*	*
pper Pit Mining Composite	*	*	*			*	*			*
stern Utah Grazing		*				*	*			*
tting Practices Composite	*	*			*	*	*	*	*	*
ire Ecology Composite	*	*			*	*	*	*		
ss Creek		*					*	*	*	*
nsect Disease Control Composite					*	*	*	*		
anta Barbara Oil Spill		*				*	*	*	*	
heeler National Wildlife Refuge			*	*		*	*	*		
iddle Snake River Projects		*	*		*	*	*	*	*	
oundard Waters Canoe Area		*	*	*	*	*	*	*	*	*
osemite Valley	*	*	*	*	*	*	*	*	*	*
ff-Road Recreational Vehicles	*		*	*	*	*	*	*		*
ransmission Line Composite							*	*		*

superimposed on natural ecosystems which land managers have frequently misunderstood. But the case studies also demonstrate that a growing comprehension of ecological processes and principles is beginning to influence resource management laws, regulations, policies, procedures and practices.

a. Ecological Considerations

The cases repeatedly dramatize two major inhibitions concerning constructive "ecological thinking" in land management decisions: (1) the gap still considered to exist between good ecology and good economics; and (2) the tendency to treat many natural ecological processes as an enemy to be stamped out (also for "economic" reasons).

A number of case studies reveal how land management policies geared to short-term economic gain may reap great bounties initially but result in long-range economic and ecological deficits. Logging practices that fail to consider effects of water temperature changes on valuable fishery resources (Pass Creek); grazing practices that leave the land barren or degrade its productive capacity (Batholith Granitic, Utah Grazing); oil drilling that may have (and nobody really knows yet) destroyed a marine ecosystem in exchange for thousands of barrels of oil (Santa Barbara); land development that degrades the environmental resources that made the land valuable to begin with (Lake Tahoe, Yosemite Valley) -- these cases and others illustrate the bankruptcy of trading ultimate ecosystem survival for short-term economic development. This type of land and water management might be termed the killing-the-goose-that-laid-the-golden-egg syndrome.

Many land managers are trained to "control" and suppress ecological processes that have been in progress since the dawn of history -- predation, fire, flood, insect infestations, plant diseases, parasites, etc. There is a tendency to fit such "undesirable" natural phenomena with a black hat, often without analyzing their role in the total web of life. It may be years or centuries before land managers discover that their control programs -- instituted usually for the benefit of economic production -- have wrought havoc on an intricately balanced ecosystem. Productive land management techniques and hazard and disease control are often necessary and desirable provided there is full understanding (based on good research) of the ecological consequences of various management practices. The long-range effects of disease or hazard controls frequently have been examined only superficially by the land management agencies. The Fire Ecology and Insect Disease Control cases illustrate these points.

The operation of certain basic "ecological principles" is highlighted by the case studies. For example:

Diversity of species and habitats produces stability (a self-maintaining system); reduction in species and habitats (simplifying the environmental systems) produces instability:

-- Pass Creek: Simplifying the forest ecosystem by clear cutting may degrade or destroy fish habitat.

-- Fire Ecology Composite: A policy of "total exclusion of fire" removes a natural vegetation management instrument that makes possible regeneration of forest species.

-- Insect Control Composite: Data on insect infestations indicate that outbreaks are "taken in stride" and controlled by natural forest dynamics in diverse stable ecosystems, but become severe outbreaks in even-aged stands.

-- Utah Grazing: Research on grazing pressures show that balance between consumers (sheep) and producers (desert shrubs and grasses) maintain a stable, productive system; too many consumers quickly reduce high-grade producers and allow unpalatable invaders (Russian Thistle, etc.) to take over the system and exclude the native plants.

-- Lake Tahoe: Massive removal of stable land ecosystems allows rapid acceleration of movement of nutrients and sediments into the lake -- hastening its aging process and totally disrupting the previously balanced land-water relationship.

-- BWCA: Cutting roads and allowing campsites to be made and enlarged by recreationists removes certain plant species, which increases the instability of the ecosystem and accelerates erosion, causing further instability.

-- Henderson Project: Ecological foresight can maintain the diversity and stability of ecosystems, keeping their multiple values at an optimum level.

-- Batholith Granitic: The originally stable ecosystems of this vast area of Idaho maintained outstanding fisheries and productive forests and meadows for millions of years; they quickly lost this balance and stability when the area was logged without ecological understanding.

b. Esthetic, Natural Beauty and Scenic Considerations

These receive special emphasis in all of the case studies for several reasons: (1) the mounting public concern for a "quality environment," which is often equated by land management agencies with esthetics; (2) responses of public land management agencies to various public pressures manifested through concern for visual impacts of various land uses; and (3) the propensity to consider esthetics only in the context of how a particular land use is to be carried out, rather than whether land should be devoted to that particular use; no land use is expected to be avoided for esthetic considerations alone.

Esthetic dimensions of public land policies and procedures are discussed in detail in several of the case studies, particularly with regard to the Henderson Project (mining), Cutting Practices Composite (logging), Transmission Line Composite and the Santa Barbara Oil Spill. In none of these cases was a land use decision conditioned on an esthetically pleasing result. This situation prompts some more cynical members of the public to react even to the most positive programs of public land agencies as a "cosmetic" approach -- covering up mistakes that shouldn't have been made in the first place. For example, no amount of landscape design consideration will justify to wilderness advocates a timber cut in a "wilderness area" since any cut, however undertaken, is unacceptable to them. (Cutting Practices Composite, French Pete Creek). Likewise, new designs, colors and materials for transmission towers are only a cosmetic approach to those who feel that undergrounding of utility lines is the only answer to the esthetic problem. (Henderson Project, Transmission Line Composite.) And the most costly and ambitious mined land reclamation program is immaterial to those citizens who feel that mining interests are allowed and even encouraged to rape the landscape under antiquated mining laws.

Unfortunately, these case studies do not disclose any new "standards" for beauty or a common terminology for expressing esthetic values. Terms such as "quality experience," "a landscape devoid of eyesores," "esthetically pleasing environment" and other equally subjective expressions appear in all of the cases. The Cutting Practices Composite case study attempts to express scenic values and esthetic impacts in a more precise manner:

> The forest may be considered by area of view, foreground, middleground and background. Management practices which reduce logging slash; improve utilization; reduce erosion; take advantage of recreation opportunities; or in some manner reduce the adverse visual impact of logging and road building, apply equally to all view areas.
>
> Any picture or scene is composed of . . . elements of design: color, form, shape, and texture. In various combinations these elements can create any degree of contrast, balance, unity or visual movement depending on light conditions and relative position of the observer.

The problem of subjective evaluation of scenic resources is touched on in several of the cases and implied in others. The Transmission Line Composite, conducted by Theodore Osmundson, a landscape architect, states: "It must be concluded . . . that what is or is not 'attractive' may vary from person to person, but that transmission lines are visually unattractive to the great majority of Americans." The Shirley Basin case study on uranium pit mining in Wyoming goes even further:

> This /esthetics/ is a very subjective issue. Opinions, in most cases, were quite predictable. Conservationists flatly opposed the mining operations. Spokesmen for mining companies normally supplied information indicating how their activities were enhancing some aspect of the area. . . . It is our opinion that an esthetic evaluation of the mining operations in Shirley Basin, by one person, is largely meaningless. As extreme examples, one may conclude either that the unspoiled surface of the Basin is attractive or that deep holes in the ground are much more interesting than a flat prairie.

Even though esthetic judgments are subjective (although Lewis, Shafer, Leopold and others have devised techniques for "quantifying" esthetic values), it must be recognized that such subjective values provide a focus for public concern over public land policies. The Santa Barbara Oil Spill case study, which contains an excellent legal analysis of the decision-making process by Malcolm Baldwin, observes:

> Any evaluation of the esthetic impact of the federal offshore platforms on the Santa Barbara environment is inevitably subjective. . . . Nevertheless, the matter must be discussed not only because the esthetic effects of platform construction were recognized as a legitimate federal concern before leasing was permitted, but also because in Santa Barbara esthetics have played a primary role in local feeling about offshore oil operations.

From the standpoint of these case studies only, it can be concluded that major public controversies over land management policy or procedures arise in two basic contexts: concern over esthetic impacts on land and water resources; and the preservation of natural and "wilderness" areas. Interestingly, the first of these concerns is related mostly to the methods or practices by which a land use is carried out, while that latter relates to whether the land use should be "allowed" at all.

c. Water Quality

Water quality appears to run a close second to esthetics as a principal environmental problem manifested in the cases. Like esthetics, the impact of water pollution results from multiple uses and is woven into the total ecological fabric. In the Lake Tahoe, Santa Barbara Oil Spill, Boundary Water Canoe Area, Pass Creek, Middle Snake River Projects and Henderson Project cases, the degradation of water quality, either by organic wastes or temperature alteration, is a primary environmental consideration. Cases like Yosemite Valley, Shirley Basin and the Batholith Granitic illustrate the need to consider specific environmental problems such as water quality in the total ecological context, rather than as isolated problems.

d. Quality Recreation Experience

Frequently defined by vague terms like "solitude," "back country," "wilderness," "isolated," "undisturbed," or "canoe," recreational quality is dealt with in several cases, notably the Boundary Water Canoe Area, Cutting Practices Composite, Yosemite Valley and Off-Road Recreational Vehicle Composite. Like the problem with esthetics, a "quality recreation experience" is incapable of being expressed in purely quantitative terms, although there are certain measurable physical factors that make such an experience possible. Dr. Robert Ream has an interesting comment on "quality" wilderness experience in the Boundary Water Canoe Area case study:

> As early as 1960 and 1961 evidence was available that the level of use in at least some portions of the BWCA was sufficient to detract from the area's wilderness qualities. . . that the most often mentioned complaint of both canoe-trippers and auto campers. . . was that the area was too crowded. Paddling canoeists were particularly sensitive to crowding and reported a loss of wilderness quality at a much lower level of use than did motor-boat users. . . . The impact of recreational use on wilderness quality is not a matter of numbers alone. The type of visitor in the area also has an impact. For example, in the BWCA, paddling canoeists were highly upset by meeting motorboats or motorized canoes.

The Yosemite Valley case study, appropriately pivoting on a discussion of the problem of maintaining a "quality" experience in our national parks, expresses it this way:

> Increasing numbers and densities of people and their internal combustion vehicles are no longer conducive to an enjoyable park experience. . . . An increasing population with increasing affluence, interests, leisure, and mobility now has the capacity to destroy the very values that the Park was set up to preserve for future generations -- unless significant changes are made in the operation of the park.

e. "Noise Pollution"

This was discussed in a surprising number of cases, notably Boundary Waters Canoe Area, Off-Road Recreational Vehicle, Yosemite Valley, Wheeler National Wildlife Refuge and Lake Tahoe. Jeeps, motorcycles, scooters, dune buggies, snowmobiles and other members of the expanding family of "recreational vehicles" are notorious noise sources. While most of the noise pollution discussion concentrated on effects on a quality recreation experience for humans, possible effects on bird nesting and migration (Wheeler National Wildlife Refuge) and other wildlife patterns (Off-Road Recreational Vehicle) are also examined in some of the cases.

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Other problems and impacts most commonly discussed in the case studies are wildlife habitat disruption, undesirable changes in vegetation patterns, disruption of total ecosystem balance, soil erosion, disturbance or destruction of fishery and threats to the integrity of wilderness (legal or *de facto*), parks or other "natural" areas. Environmental hazards are also discussed -- earthquakes in the Santa Barbara case, and flood and fire dangers in the Cutting Practices Composite.

f. Lack of Data Key Problem

The most conspicuous "environmental problem" discovered by the case studies, and which will come as no surprise to the ecologist, is the manifest absence of data available to the agencies when making various land use decisions. Or, if data were available, the extent to which it is ignored. The environment, more often than not, is presented with a *fait accompli*. This has resulted in polarization against land management agencies by citizens incensed at environmental damage they felt could have been mitigated or avoided. The agency, extremely sensitive to "outside" criticism, assumes a defensive position and hustles around to further justify its decision, or tries to repair the damage. Studies have been launched too often to investigate the effects of decisions that might not have been made had the same studies been conducted by the agency as a *condition precedent* to the land use decision. According to the Batholith Granitic study: "Probably responsible for most management oversights is the lack of basic information and data. Without the needed data, interpretive and management decisions tend to be arbitrary or based on some assumptions later proved valid or erroneous." Examples from the cases:

- practice of the Forest Service in California has been to wait until interference by off-road recreational vehicles with other multiple uses is "intolerable" before taking action to repair damage *already* caused, instead of taking "preventive" action

- only after Yosemite Valley in California had been "drained, ditched, dammed, dumped, blasted and built" did the National Park Service gather data and implement management policies to try to restore it to what it was when managed by the Indians

- uncertain Forest Service policy and lack of data on human impact resulted in "riddling" the Boundary Water Canoe Area with temporary roads which soon became permanent avenues of human impact -- in an area *now* being managed as a Wilderness

- in the Pass Creek case in Oregon, the philosophy of the BLM was to "cut now, get the facts later" as to the effects of water temperature changes on native steelhead trout, reported by local fishermen to be declining from thermal pollution generated by timber practices

- partly due to the fact that the Bureau of Sport Fisheries and Wildlife did not have adequate data on possible environmental

TABLE II

LEGAL, PROCEDURAL OR POLICY PROBLEMS ASSOCIATED WITH LACK OF SUFFICIENT ENVIRONMENTAL CONSIDERATIONS IN PUBLIC LAND MANAGEMENT DECISIONS

a. Lack of Authority Over Land Use Decision
b. Lack of Authority Over Land Management
c. Inadequate Inter-Agency Coordination
d. Insufficient Environmental Fact Finding
e. Inadequate Land Use Planning
f. Insufficient Public Participation in Decision-Making
g. Inadequate Agency Personnel (Numbers or Training)
h. Lack of Funds
i. Conflict Between Agency "Mission" and Environmental Quality
j. Failure to Consider the "Environmental Imperative"

		a	b	c	d	e	f	g	h	i	j
atholith Granitic		*		*	*	*	*	*		*	
ake Tahoe				*	*	*	*	*			*
enderson Project		*	*					*			
irley Basin		*	*	*	*	*	*				*
opper Pit Mining Composite		*	*	*	*	*	*				*
estern Utah Grazing					*	*				*	*
utting Practices Composite				*	*	*	*	*		*	*
re Ecology Composite					*			*		*	*
ass Creek				*	*	*	*	*	*	*	*
nsect Disease Control Composite					*			*	*		*
nta Barbara Oil Spill				*	*		*			*	*
eeler National Wildlife Refuge		*		*	*	*	*	*	*	*	*
ddle Snake River Projects		*		*	*		*			*	*
oundary Waters Canoe Area					*	*	*	*		*	*
osemite Valley					*	*		*		*	*
f-Road Recreational Vehicles	BLM		*		*	*		*	*	*	
	USFS				*	*		*		*	*
ansmission Line Composite						*	*			*	*

impacts, Interstate 65 in Alabama may cause irreparable harm to Wheeler National Wildlife Refuge; impact data will be gathered after the highway is built

-- now that 90% of the spawning beds on the South Fork of the Salmon River in the Idaho Batholith have been destroyed, the Forest Service has started to consult with various outside specialists on how to repair the damage; says the report: "In most instances, studies and surveys followed significant damage or crises." (Emphasis added.)

-- both private and public development have threatened to "kill" Lake Tahoe with pollution beyond recovery, and destroy its scenic resources; now several agencies are calling for a "moratorium" on types of development which might have been properly controlled in the first place.

As the cases demonstrate, under the present system of "project" orientation and justification for funds it is doubtful if any of the above could have received funds for a study that would have prevented the problem. Crisis-oriented research frequently comes too late.

At least two types of environmental impacts are not discussed adequately in the cases, mostly due to lack of data: effects of pesticides, herbicides, and "spraying" programs on wildlife, fishery and other components of the ecosystem; and the effects of the presence or absence of "prescribed burning" in lieu of various logging and insect control practices (although the case study on Fire Ecology provides an excellent analysis of prescribed burning as a land management tool).

II. Legal, Procedural and Policy Problems Associated with Environmental Problems and Impacts

a. Authority

Consideration of a public land management agency's authority to adequately consider the environmental consequences of a particular land use decision arises, according to the cases, in several contexts: (1) the extent of the agency's authority to determine the type of land use (mining, grazing, logging, power development, etc.); (2) the extent of the agency's authority to control the ways in which the land use is carried out; and (3) the extent to which the agency exercised whatever authority it did have.

As to most types of public land uses, the managing agency does have some authority to consider many environmental impacts and develop appropriate regulations, rules and procedures. This seems to be particularly true of the Forest Service. Lack of authority to consider environmental quality presents the greatest problem in the mining cases. Under the Mining Law of 1872, federal agencies lack authority either to determine whether or not land shall be mined or to regulate the way in which it is mined. In Shirley Basin, Copper Pit Mining and Henderson Project, consultants came to the conclusion that the Mining Law will have to undergo drastic revision if the environment is to be protected; that it does not make sense for land management agencies to have jurisdiction over every other type of land use except mining; that mining should no longer enjoy its privileged sanctuary from environmental quality control.

Open pit mining and storage of mine tailings is a "total destruction of the terrestrial desert ecosystem" (Copper Pit), where the "impact is total and involves complete disturbance of the pre-existing surface" (Shirley Basin). The granting of a mineral patent carries with it no requirement for environmental consideration. Dr. Patten observes in the Arizona mining study: "under the present mining laws, once the federal government relinquishes control of an area through mineral patents, it has no further control of the environmental impact of mining . . . essentially, the hands of the federal government are tied by the 1872 law."

The Henderson Project case points out that the Forest Service can do little to protect the environment except offer its good offices and cooperation whether the mined land is patented or acquired under the Forest Exchange Act. In Shirley Basin, it was observed that the Bureau of Land Management was a mere bystander, that "in terms of providing any significant control over either exploration or development . . . this (mining) law is virtually ineffective."

In most cases studied, the state either had inadequate regulatory authority or did not properly exercise the authority it had. In Arizona, companies can lease state land for tailing disposal for \$32.50/acre/year without any written laws or agreements on stabilization. There is a "general understanding" that the companies will "try" to stabilize, and some of them have. The reluctance of the Wyoming State Health Department to press the Atomic Energy Commission for a thorough investigation of possible radioactive pollution from uranium mines felt to be contributing measurably to the state's economy was pointed out in the Shirley Basin case.

A land management agency may have adequate authority to study or practice environmental quality control but be handicapped by lack of funds, lack of qualified personnel, or plain absence of "ecological" motivation. The "mission" of the agency may also interfere with the exercise of authority to consider environment. Examples:

- -- the Bureau of Land Management has inadequate authority to regulate the use of off-road recreational vehicles in California; nevertheless, it would rigidly enforce vehicle restrictions if it had funds and manpower for policing; the Forest Service, on the other hand, interprets its mission a little differently and considers off-road vehicle use a "legitimate" use of Public Lands "unless such use causes damage or presents a public hazard"

-- the Forest Service had adequate authority to protect the wilderness resources of the Boundary Water Canoe Area prior to passage of the Wilderness Act of 1964; a vacillating policy, expressed by ambiguous terms like "semi-wilderness," "near-natural," and "wilderness-like," destroyed some wilderness values with roads and logging before the Act of 1964

-- prior to a major controversy over damage to valuable stream fishery by logging practices on the Pass Creek District of Oregon, the BLM exercised little of its authority in environmental control; as a direct result of intensive public pressure, the BLM demonstrated its authority to conduct special fisheries research, issue a detailed manual on stream protection, and hire 11 new scientific professionals. Pass Creek seems to demonstrate the absence of legal obstacles to the exercise of authority if the agency wants to exercise it

-- the U.S. Geological Survey, the Corps of Army Engineers, and other levels of the Department of the Interior generally have adequate authority to regulate oil drilling on the Outer Continental Shelf but environmental considerations have been secondary to other "missions," e.g., federal leasing revenues (Santa Barbara)

-- failure of the Federal Power Commission to adequately consider the environmental dimensions of its mandate and authority to protect the public interest in licensing proceedings, has resulted in recent court remands -- High Mountain Sheep, Idaho and Scenic Hudson, New York (Middle Snake River Projects)

b. Coordination

"Coordination," or lack thereof, as a source of environmental problems on public lands must also be considered in several contexts: (1) whether there was "adequate" coordination with local, state and federal agencies, and private user groups, prior to the land use decision; (2) whether the agency really altered any of its plans after coordination, or whether as a "proponent" its ideas always prevailed; (3) whether the agency employed (or listened to) any outside expertise; and (4) whether the coordination was "real" or was a mere going through motions to satisfy procedural requirements.

With the exception of the Fish and Wildlife Coordination Act, often narrowly applied to "water development" projects like the proposed Middle Snake River power projects, the cases discuss few legal requirements for coordination. Where legal requirements exist, the methodology for coordination (meetings, reports, disclosures, review, etc.) appears to be a matter of agency discretion. Good or "adequate" coordination seems to occur only when the agency really wants it to happen. It is of interest that in the Henderson Project the real coordinating instrument was not a public land agency at all but the Climax Molybdenum Company which insisted on close coordination with the Forest Service, the Bureau of Sport

Fisheries and Wilflife, the Colorado Department of Game, Fish & Parks, various other industry groups, and conservation oriented citizen groups.

Attempts at coordination can also backfire with a resulting polarization of positions. The effects of uranium mining in Shirley Basin, Wyoming on water quality would seem a natural coordination opportunity in which agencies with various expertise could work together. Nevertheless, the "proponent" and "opponent" schism appears. Research by the Wyoming Game and Fish Department indicated levels of radioactive water pollution "two orders of magnitude in excess of lethal limits for trout and three orders of magnitude in excess of Atomic Energy Commission standards for process effluents." The Department collected 24 dead songbirds from one of the mining company settling basins. Instead of a cooperative investigation, these "charges" were vigorously denied by both the AEC and the State Public Health Department. Wouldn't a joint investigation have produced a more desirable result, for the benefit of both the mining companies and the public? As the case study notes, "it follows that any precise statement relating to evaluation of the ecological impact of the uranium mining would founder through shortage of data. This situation is compounded by lack of coordination and cooperation amongst the government agencies . . . ."

Coordination and cooperation can produce extremely valuable information. The California State Office of BLM and the Western Regional Office of the National Park Service jointly published a 1968 recreation impact study called "The California Desert." Coordination with citizen groups, including recreational vehicle user clubs, and with the Forest Service produced the study and has continued in a productive fashion. Resource inventories, multiple use priorities and positive action programs are being developed to the benefit of the agencies and the public, even though funds are not yet available to carry out many of the proposals. Similar coordination techniques have proved equally fruitful on the Teton National Forest, according to Cutting Practices Composite. Reseeding of range described in the Utah Grazing study is another example.

Perhaps the case study that best exemplifies the environmental crises that can occur without adequate inter-agency coordination is Lake Tahoe. Raymond M. Smith, planning consultant for the Nevada Tahoe Regional Planning Agency, has prepared a matrix of agencies and their functions, revealing eight levels of government and 75 concerned agencies or interested groups, ranging from the Forest Service and the Department of Housing and Urban Development to the League to Save Lake Tahoe. Recent appeals for a "moratorium" on all development in the Tahoe region seem to be pleading: "Hold everything until we get organized!"

In the case of the proposed Interstate 65 through the Wheeler National Wildlife Refuge in Alabama, the Alabama Highway Department (whose federal funds are "coordinated" by the Bureau of Public Roads) took two years to answer an inquiry from the Bureau of Sport Fisheries and Wildlife regarding the proposed route location. Earlier, the Tennessee Valley Authority, the Corps of Engineers, the Bureau of Public Roads and the Redstone Arsenal -- carrying out un-coordinated federal programs -- had reduced the Refuge from 45,000 to 35,000 acres.

It also seems to depend on who is doing the coordinating. For example, in the Wheeler Case, the TVA originally supported the BSF&W-proposed "Alternate #1" to mitigate damage to the Refuge from the Interstate. But following a "coordination" meeting with the Federal Highway Administration, the TVA became "noncommital" about the route location.

No one case study defines what "adequate" coordination is but the cases do suggest some guidelines: (1) coordination should occur at the earliest possible stages of project or land use planning, not as a tardy afterthought; (2) coordination should be conducted with sincerity and openness, allowing full disclosure of the planning process -- it cannot be an adversary proceeding; and (3) coordination should produce a result other than a "rubber stamp" on the original intentions of the proponent agency. The Henderson Project and the Teton National Forest (Cutting Practices Composite) cases seem to come closest to meeting these criteria. While the Transmission Line Composite discloses excellent cooperation between the Forest Service and various power companies, other government agencies and citizen groups seem to have been left out of coordination efforts.

c. Research: Environmental Studies

The cases suggest that research on land management policies, procedures and decisions should be framed by these questions:

(1) Was an adequate study on possible environmental effects done prior to the particular land use decision?

(2) Did the results of environmental studies really influence the decision? Or were they made merely to satisfy legal or procedural requirements?

(3) Did the environmental studies consider not allowing the proposed land use, or were they confined to minimizing or mitigating contemplated impacts?

(4) Was the "proponent" agency also given exclusive responsibility for making environmental impact studies related to its own project?

As was concluded earlier, the lack of ecological data sufficient to make an intelligent land use decision is the most conspicuous environmental problem occurring through the cases. The cases generally suggest that total environmental impact studies are incompletely done prior to the land use decision -- unless a public hue and cry over a contemplated decision plunges the agency into a public controversy. Again, lack of adequate personnel, either in number or in training, and lack of sufficient funding are the most frequent obstacles to early environmental studies. Also, the "mission" of the agency is not generally oriented toward ecological effects.

Where the agency has no authority over the type or character of the land use to begin with, as with the mining cases, budgets are not likely to be allocated to environmental studies. This is why the expensive voluntary programs of companies like those described in the Copper Pit Mining Composite are so bereft of good ecological data; most of their reclamation and other environmental quality control work is still "experimental," nearly 100 years after the Mining Act of 1872. The data available on the impact of mining, milling, tailing deposition, exploration, road building, water use and similar disturbances on regional ecosystems is virtually non-existent.

Adequate environmental studies may be conducted, with consequent management recommendations, but not be used for a variety of reasons. The excellent study on "The California Desert" produced a number of new management guidelines, but funds are still not available to put these recommendations into practice.

The "political" climate may also interfere with implementation of a study recommendation. For example, recreation impact research conducted by the Forest Service in the Boundary Waters Canoe Area has resulted in a number of new management techniques to prevent campsite deterioration, etc. But equally thorough research and recommendations on conflicts between BWCA users -- particularly motorboats vs. canoes -- has reportedly had no effect at all on management policy; apparently, the issue has been decided in the "political" arena.

The Middle Snake River Projects case points out that numerous environmental impact studies were available to the Federal Power Commission from both public and private sources but were given little weight in licensing proceedings and comments: "There seems to be a grave procedural block to full consideration of environmental issues relevant to the public interest." The point is that the FPC minimized the role of environmental information as a decision-making tool. Largely as a result of ecological studies, Secretary of Agriculture Orville Freeman recommended in 1968 that High Mountain Sheep Dam not be constructed. The Department of Interior, after reports from eight Interior agencies, urged a moratorium. In what is clearly an understatement, the consultant observes: "It is not at all clear that these studies have been used in the decision-making process." Contrast this to the "Leopold Report" on national park management which contributed to a decision by the National Park Service to make a major policy switch on "prescribed burning" in West Coast sequoia forests (Fire Ecology Composite).

Problems also arise when the land management agency assumes a mere "custodial" role while gathering shallow ecological data about its charge. It then becomes an easy target for project-oriented agencies like the Bureau of Public Roads. Dr. Cox observes that "a full evaluation of the impact of I-65 on Wheeler National Wildlife Refuge cannot yet be made" because the Bureau of Sport Fisheries and Wildlife, which manages the Refuge, isn't getting the data. He points out that BSF&W estimates of environmental impacts are based on "general" information and "subjective" evaluation rather than hard scientific analysis; that no qualitative data is available to support the BSF&W position in favor of an "alternate" to the proposed interstate highway. He feels that the failure of BSF&W to have hard data on waterfowl use in all parts of the Refuge was detrimental to its case because: (1) the Alabama Highway Department and the Bureau of Public Roads remained "unconvinced" that the feared impact was really serious; and (2) absence of competent data placed the BSF&W in a very weak position with the Department of the Interior.

Considerable data on fire ecology and prescribed burning as a positive forest management tool is available in both government agencies and private institutions. Yet, as the Fire Ecology Composite points out, the Forest Service has advocated the "Smokey Bear" philosophy -- virtual fire exclusion -- since 1905. Every time a "big" fire occurs, frequently due to a fuel build-up which prescribed burning would have reduced, the Forest Service requests more money for more roads, fire-fighting equipment and manpower. "The fuels then continue to build up again. . . another big wildfire occurs, and so the cycle continues." Only recently has the Forest Service recognized that it can no longer continue to ignore the evidence accumulated by responsible research.

d. Planning

Planning is sometimes paraded as a panacea for all environmental problems. But the planning device can also be misused: It can be employed to postpone any land use decision indefinitely, or it can provide a handy excuse to justify almost any decision, good or bad. Planning as an environmental consideration should be approached in several contexts: The "adequacy" of planning (long-range or short-range) prior to the decision; the degree to which planning proceeds on the assumption of "economic benefit" from the land use decision; the relationship between planning and practice; and the extent to which planning was a factor in the land use decision.

The time period for this study did not allow for more than a cursory inspection of the planning process. All land management agencies do some planning (e.g., Forect Service "multiple use" plans; BLM "classification"; Park Service "master plans," etc.) but the cases indicate that planning procedures and the availability of qualified personnel varies widely.

Planning occurs both before and after the fact of environmental damage. There is no federal planning in the mining cases, only the voluntary planning undertaken by some mining companies. Even in the Henderson Project, the author points out, there is presently absent a long-range plan (50 years) for what should be the ultimate disposition of the property when mining operations have ceased. Past experience is a major planning guide to the BLM in California which is planning not to open certain new areas for recreational vehicles because of past destruction in other areas. The Forest Service is criticized in several cases (Off-Road Vehicle, Boundary Waters Canoe Area, etc.) for planning for certain impacts only after the damage has occurred. The Cutting Practices Composite suggests that there have been too many uses on the National Forests before planning sets in; that most multiple use plans come too late.

Prolonged planning can also cause the agency to lose the initiative, to its great frustration. In 1957, the Forest Service decided to omit 53,000 acres from the French Pete Creek Primitive Area and devote it to multiple use, i.e., logging. This precipitated a major public controversy with conservation groups and wilderness advocates, resulting in a reaffirmation of the original decision in 1969 -- after 12 years of planning. Result: A special bill introduced in Congress to protect the area from logging, road construction and motorized equipment.

e. Public Participation.

Were there established legal, administrative, or "custom" devices to ensure public participation in the decision-making process? Was the opportunity for public participation meaningful, or a mere formality? Is there a "pattern" of agencies making information available to their supporters but not to their opponents in a particular decision? Was the public participation early enough? Did it in fact influence the decision at all? These are some of the questions asked or implied in the case study analysis. Not all of them are answered.

/Author's Note: It would be helpful if someone would devise a public participation "model" which every agency could adopt; few of the cases suggest one. Public participation is usually equated with public "hearings" which are frequently mistrusted by minority opinion holders. Hearings are characterized as "cut and dried," "rubber stamp," "undemocratic" and an opportunity for "vested interest groups" to pad the record and overwhelm the hearing officer. Most citizens are convinced that the agency has already made up its mind before it calls a public hearing anyway./

As the cases emphasize, no hearings are required for mineral exploration, mineral patents, mining operations or tailing disposal methods. The Henderson Project appears to be the best example of public participation in the cases, but the participation was generated by a private company, not a federal land management agency. In the Henderson case, public participation came at the earliest possible stages of planning -- five years before anticipated operations. The Shirley Basin case points out that nobody protested the uranium mines -- no political, economic, social or conservation block said a word. But when did they have an opportunity to voice an opinion? Not until, the authors say, the mining operations had become a fait accompli.

Aside from Henderson, certainly a unique case, there are other examples of excellent public participation in the case studies.

- -- the California office of the Bureau of Land Management has held extensive formal meetings with all user groups on the problem of off-road recreation vehicles. Vehicle users, and their "opponents," are well represented on the Off-Road Vehicle Advisory Council (ORVAC) whose recommendations are often implemented by BLM

- -- the Forest Service in California has been careful to advise recreational vehicle users of restrictions, closed areas, etc. and has held numerous meetings with vehicle clubs. The result: Good compliance from club members with vehicle rules and regulations. (Of course, the most notorious offenders don't belong to clubs.)

- -- although precipitated by a major controversy, Forest Service appointment in 1964 of the "Silke Committee" to advise on policies, regulations and guidelines for the Boundary Waters Canoe Area has had constructive results; not all of the public is delighted with the result, of course

- -- officials of the Teton National Forest consulted the public early and frequently in multiple use planning and utilized the expertise of numerous outside specialists. "The result of working closely with the public was wide-spread acceptance of the multiple-use management plan."

Public participation has not been so rosy in other instances. The Cutting Practices case points up the great schism that has developed between professional forester "conservationists" and citizen outdoor recreationists, naturalists and wilderness enthusiasts, many of whom are also knowledgeable about ecology, esthetics and land management problems. Timber harvesting and road building always seem to be the great dividers and no amount of dialogue completely transcends this barrier. It seems that logging is logging and wilderness is wilderness and never the twain shall meet. Other examples:

- -- public hearings (before the "two-hearing" procedure was required on federal aid highways) on Interstate 65 through Wheeler National Wildlife Refuge were ineffective for broad citizen input -- only one citizen supporter for the BSF&W showed up at the one hearing. Others of the public had the same opportunity but not enough information about either the issue or the hearing to appear. The citizens were also poorly organized

- -- while a Batholith Steering Committee was organized in Idaho in 1968, it consists mostly of professional management people and has little contact with the public

- -- in the Lake Tahoe area of Nevada and California, some members of the public claim to have been largely ignored by the agencies,

> local, state and federal, with the result that some citizens are now resorting to lawsuits

Sometimes the scope of the inquiry allowable at the hearing by the agency makes the whole procedure rather meaningless. For example, in 1967 the Corps of Army Engineers (which had already authorized our oil platforms off the Santa Barbara coast under its jurisdiction over navigable waters) decided to hold public hearings on a platform proposed by Phillips Petroleum. However, the hearing could consider only the effects of the platform, not whether the lease itself would be granted. Permit approval was therefore a foregone conclusion, since the USGS had already approved Phillips' position and had urged the Corps to grant the permit.

Some of the case studies imply that the degree of public participation in management decisions depends much more on the personality, attitude and philosophy of the individual supervisory land manager than it does on laws, regulations and policies. Even if clear-cut policy is lacking, there is no law against discussing public land problems with the public. It is no secret that some user groups and citizen organizations wait in great expectation for a new "administration" who will listen to them. Dale Carnegie techniques perhaps apply to selling land management decisions as well as to selling automobiles.

f. Personnel

Whether the land management agency has "adequate" personnel, either in number or in scientific qualifications, to properly consider environmental effects is always a valid inquiry. Even if enough qualified personnel are available, their effectiveness might be inhibited by philosophical attitudes of their superiors within the agency, absence of motivation, certain types of political coercion or possibly even "muzzling" of ecologically oriented opinion.

The Batholith Granitic case makes this interesting comment on the personnel problem:

> Management using multiple use concepts . . . has meant new obligations and heavier responsibilities for the Forest Service. Another facet in the origin of the problem is in the limited size, training and use of professional staff. The technical staff is too small and has had insufficient support to conduct the necessary surveys. . . to conform to the requirements of the Multiple Use-Sustained Yield Act of 1960 . Administrative staff also were slow to adjust to some of the new concepts and few were trained to consider environmental impact. . . . Recommended changes or suspension of practices resulting from internal and external research staffs were slow to be implemented and in some cases were implemented with reluctance. . . . This agency, like others involved with land management, changes slowly

> and the hierarchy in decision making tends to ensure that individuals most resistant to change are in positions most capable of implementing change.

In the recreational impact cases, the problem has not been so much a lack of personnel to help make decisions as it has been to get enough people to carry them out. Enforcement of the Panoche Hills, California recreational vehicle management plan has not been possible due to lack of manpower for policing; 70% of the users fail to heed the signs. The same thing is true of enforcement of boating and camping regulations in the Boundary Waters Canoe Area.

The Cutting Practices case makes this observation about the background and training of Forest Service personnel:

> Thirty years ago a few schools of forestry began curricula in fish and wildlife management. Recreation management was hardly known. Watershed management was just a part of ecology and silviculture. Today, curricula in forest recreation, in fish and wildlife management and in watershed management are widely available and well developed. But forest esthetics and forest landscaping are still in earliest infancy.

g. Funding

One of the standard excuses for not conducting environmental studies or otherwise "considering" ecology is lack of funds. Is this really valid? If the agency budget is poverty stricken, it is legitimate to inquire whether the agency used outside expertise funded by private sources or supplied by volunteers.

The relationship between funding and availability of personnel to research environmental problems or implement environmental practices has already been pointed out. Lack of funds for environmental investigation may also be related to the mission of the agency. The Cutting Practices case points out: "Funds are appropriated to the land managing agencies for specific purposes. Activities like timber management and recreation are financed. But esthetics is not. Any expense for esthetics must come from funds of a financed activity."

Much road development, for example, is financed from timber sales which dictate the location and to an extent design standards for such roads. Timber harvest rather than environment or esthetics is the major consideration. Also, when a timber company must pay for roads, it tends to log more intensively to protect its profit margin.

Environmental quality does not fit traditional cost-benefit analysis, whether for dams and reservoirs, power plants, timber sales or highways. Yet, environmental "considerations" are generally assumed to cost more -- a cost to be borne without measurable benefit compensation. The "economic imperative" is exemplified by the Wheeler National Wildlife Refuge case in which the Bureau of Sport Fisheries and Wildlife's

"Alternate #1" to protect Refuge values was rejected by the Bureau of Public Roads because it was two miles longer (greater "user" costs) and added $2.4 million to a $15.5 million project. The implication is that any added cost for environment is too much. "Social cost" and "social benefit" have only recently entered the cost-benefit vocabulary. But environmental considerations such as controlled burning are often cheaper, with greater social and resource benefit. Shirley Basin makes the point that the costs of environmental resources must be evaluated as non-renewables.

Although none of the case studies analyzes the funding problem in depth, a strong inference can be drawn that lack of funds is rarely the primary reason for ignoring environmental effects. The Pass Creek case -- where public pressure for fishing stream protection produced an almost miraculous "budget" from the BLM for environmental studies and staff -- demonstrates that necessity is still the mother of invention. It also suggests how an agency might get new appropriations.

h. Mission

Sometimes the mission or Congressional mandate of the agency is or seems to be fundamentally in conflict with protecting or maintaining certain environmental resources; the agency's "mission consciousness" (to harvest timber, develop hydroelectric power, build campgrounds, serve "thousands" of visitors, provide cattle forage, etc.) actively interferes with environmental considerations. But there is also evidence that many of the old missions are changing due to a new national concern for the environment and a new awareness on the part of the agencies.

The absence of a mission to consider and protect the environment results in as many problems as overemphasis on the wrong mission. The Bureau of Land Management, for example, has been considered as an "interim" agency to be the custodian of certain public lands until they were "disposed of" for the public benefit. As the Off-Road Vehicle case shows, the BLM was not historically equipped to deal with recreation problems and recreation planning; it had no real status on many matters until the Classification and Multiple Use Act of 1964. It still has few enforceable management rules and regulations to protect environmental quality.

Apparently, the Forest Service in the Boundary Waters Canoe Area case blew its management trumpet with uncertain sound for 25 or 30 years until the Wilderness Act of 1964 firmed up its mission in that region. There had been no clearly defined management objectives; each "goal" was given a new interpretation by each successive USFS administration. "The problem. . . is not one of land management decisions that have been made but . . . the lack of decisions by the agency." (Emphasis added.)

Indeed, the cases suggest that the mission of the agency, or what it interprets its mission to be, may generate more environmental problems on the public lands than any other single factor discussed in this

Summary. (See Wheeler National Wildlife Refuge, Middle Snake River Projects, Santa Barbara, Yosemite Valley, and Pass Creek cases, for examples.) This might be called the damn-the-ecology-full-speed-ahead attitude. For example, in Douglas County, Oregon (Pass Creek case) the timber economy has been steadily decreasing in recent years while a whole new recreation economy oriented to the steelhead trout sport fishery is making great gains. Steelhead trout depend on the clear, cold, uniform flow of the North Umpqua drainage. Yet, agency insistence on clear-cutting along stream banks has increased water temperatures and threatened the whole steelhead economy! Historically, the mission in Douglas County has been to cut timber, not harvest trout.

The Pass Creek case makes an even broader statement: ". . . in short, laws are adequate to protect the aquatic environment. Failure comes in practice." This is deemed to be true because: (1) demands for timber have historically exceeded demands for "environmental activities"; (2) funds have been allocated primarily for road building and timber harvesting; (3) staffs are trained, skilled and motivated primarily for timber management; and (4) government economy moves have resulted in environmental considerations being "short changed: as greater shares of the budget are allocated to timber harvesting. Other examples:

- -- Cutting Practice Composite: "On the side of traditional forestry the problem is rooted in road building and clear-cutting practices, which were determined in large measure by economics, engineering and silviculture considerations. The amenities were short-changed."
- -- Batholith Granitic: Despite Forest Service supervision, decades of indiscriminate overgrazing and road-building malpractice have irreparably marred the pristine Batholith landscape. There has been little or no concern with environmental impact . . . ."

There is no question that many of the traditional land management agency missions are changing to meet new public demands, particularly the demand for environmental quality. But the process of change is slow and agonizing, particularly for agencies like the Forest Service with a long and proud tradition of public service and detailed management procedures established over nearly 100 years. New Laws, regulations and policies, suggest the case studies, may be needed occasionally to remind the agencies of their changing mission in a changing world.

i. Environmental Imperative

The environmental imperative, notably lacking in most of the case studies, might be expressed by this question: Were considerations of environmental quality a condition precedent to a particular land use decision, the same as economic feasibility? Was a land management decision postponed or cancelled altogether due to anticipated environmental impacts?

A major problem which the case studies seem to disclose is that the environment is only a "consideration" in a land use decision, an afterthought, one of many other factors. While a proposed project may fail for lack of economic feasibility, there is little evidence to suggest that many projects would fail for lack of environmental feasibility. Environmental consideration seems to be expressed generally in terms of "minimizing" or "mitigating" environmental damage, not in terms of avoiding it altogether.

There are a few occasions cited by the cases which indicate that the environmental imperative can operate in "special" circumstances, such as:

-- the withdrawal from mining of 7½ square miles of Bureau of Land Management land on Mt. Hopkins near Tucson for a Smithsonian Institute Astrophysics Laboratory, on the assumption that mining activity would damage the ecosystem

-- the BLM closing of Panoche Hills, California to recreational vehicle use during peak periods of grazing and bird nesting

-- elimination by the National Park Service of numerous "user days" of camping activity and cancellation of the "fire fall" to protect and attempt to restore the ecology of Yosemite Valley

-- the Teton National Forest multiple use plan which purports to give first consideration to environmental quality and secondary consideration to commercial forest uses

-- the de facto "moratorium" of High Mountain Sheep dam on the Middle Snake River to protect Hell's Canyon (although license proceedings are still pending before the FPC)

-- curtailment by the Forest Service of road building and logging along the South Fork of the Salmon River, Idaho in 1968 to protect the fishery resource

Perhaps the most dramatic example of dominance of land management policy by the economic imperative in the 17 case studies is Wheeler National Wildlife Refuge. From the beginning, the Bureau of Sport Fisheries and Wildlife was precluded from considering whether the Interstate 65 should cross the Refuge; it was confined to determining how the damage might be minimized or mitigated. But even BSFW recommendations on that score were rejected because additional costs were in conflict with other "economies" sought by the project. The Santa Barbara Oil Spill might never have occurred had not the Bureau of the Budget (not just private industry) pressed so hard for development of Outer Continental Shelf lands for U. S. Treasury benefit.

III. Suggested Alternative Laws, Regulations, Policies, Practices or Procedures for Avoiding or Mitigating Environmental Problem Origins or Impacts Described in the Cases

The following suggested alternatives are not presented as all-inclusive. They have been implied or expressly stated by the case study consultants; they are not the unilateral suggestions of the Contractor.

a. Legal Authority Alternatives

1. Amend the Mining Law of 1872 to permit regulation of environmental effects by the Land Management Agency. Specific suggestions include:

    (a) Recognizing the potential of modern technology to discover mineralization with the necessity of scarring the surface.

    (b) Dropping the present approach of locating minerals in favor of an approach which would permit the federal agency to impose conditions upon development. Some consultants prefer a leasing system. Others feel that a system of patents provides greater incentive for the miner to develop the property carefully.

    (c) Require the mining claimant to apply for lease or patent, submit ecological impact study reports and go through a public hearing procedure.

    (d) Provide for preliminary exploration permits, appropriately conditioned to protect environmental values.

    (e) Authorize the federal land management agencies to require satisfactory rehabilitation of the land and removal or rehabilitation of the tailings disposals.

2. Extend and strengthen the authority of the Bureau of Land Management to plan, implement and regulate multiple uses within its jurisdiction, including recreational uses. Such legislation should make it clear that protection of the environment and enforcement of water quality standards applicable to the federal public lands.

3. Authorize the establishment and enforcement of water quality standards applicable to the federal public lands.

4. Strengthen authority for cooperation and unified regulation in areas of overlapping or alternating jurisdictions, whether inter-agency or federal, state, local and private.

5. Utilize existing authority more fully. For example, land management agencies might require environmental protection as a condition of land exchanges, special use permits and easements.

Agencies such as the Federal Power Commission, with a statutory mandate to protect the public interest in environmental values, should exercise that authority more vigorously.

b. Coordination Alternatives

1. Provide appropriate inter-agency and intra-agency monitoring systems to determine if "adequate" coordination on environmental matters actually takes place; establish "models" to define "adequate coordination."

2. Coordinate at the earliest possible stages of planning, not after plans have already been established.

3. Improve coordination between federal and state management agencies by fuller exchange of information and joint approaches to common problems.

4. Improve coordination within a federal management agency by measures such as:

   (a) Insuring that all agencies with environmental expertise within a department, such as Interior, participate in decisions where their expertise would be helpful for environmental protection.

   (b) Internally, providing adequate lead time so that studies may be conducted and coordination effected before a decision must be made.

   (c) Conducting educational programs within the agency to develop an awareness and appreciation of new priorities.

5. Utilize the knowledge and expertise of outside sources from other government agencies, universities, private industry and private citizens; don't confine coordination to agency coordination.

6. Insofar as direct federal regulation may be unacceptable for particular land uses, expand the role of the land management agencies as consultants for private companies.

c. Research and Environmental Study Alternatives

1. Develop basic ecological data about the ecosystem subject to being impacted; conduct impact studies on the potential effect of various land uses. Classify those areas which are unsuitable for particular uses before the damage occurs.

2. Design studies to suggest measures to resolve problems, not simply to define them; then utilize the information obtained.

3. Coordinate studies on specific subjects.

4. Improve techniques for fact gathering and evaluation of environmental impacts.

5. Expand studies into new areas, such as forest landscaping and its relation to all multiple uses.

6. Require private companies to submit certain "proprietary" information developed by them, with appropriate safeguards. Do not, however, rely solely upon information and studies provided by development interests.

7. Require trial of new technologies in areas of minimal environmental impact before relying upon them in sensitive areas.

8. Consider having a two-year ecological study prior to any mineral development, paid for in part by the mining company involved and followed by "post disturbance" monitoring.

9. Establish monitoring systems to gather vital ecological data while the land use is in process (on air, water, aquatic habitat, vegetation, etc.)

10. Establish inter-disciplinary "teams" of environmental investigators to marshal the scientific facts on various land use conflicts and controversies.

d. Planning Alternatives

1. Develop a broad, area-wide ecological approach. View the planning operation as one relating to the land rather than to individual resources. Consider also the environment of surrounding areas so that federal uses do not have an adverse effect on non-federal lands.

2. Classify the public lands by types of environmental impact the land is capable of withstanding in order to recover, rather than by land capability potential based on greatest unit of output.

3. Adopt a flexible approach to particular problems, considering the factors that are peculiar to the local environment.

4. In considering particular land uses, provide some basis for "weighing" relative values.

5. Avoid single-use, emergency reactions to situations where there is no overall plan.

6. Grasp opportunities to deal with obvious environmental problems in their incipiency.

7. Clearly define management objectives and the objectives of control projects, and insure that there is uniform interpretation of implementing directives within the agency.

8. Establish criteria for instituting necessary "rationing" systems (e.g. in national parks) based on "carrying capacity."

9. Rethink the entire planning approach to "maximizing" outdoor recreation experience on the public lands so as to establish criteria for "optimizing" recreation experiences.

10. Devise environmental resource inventory and analysis techniques to guide all public land use decisions toward "maximizing social benefits at least social cost."

e. Public Participation Alternatives

1. As with coordination, encourage the broadest possible public participation at the earliest possible stages of planning.

2. Supplement traditional public hearings, often too late in the decision-making process, with informal meetings, conferences, symposia and other dialogue with interested members of the general public.

3. Utilize the sources of knowledge which sometimes are untapped, such as the academic community.

4. Improve the efficacy of public hearings by measures such as:

    (a) providing notices that actually notify the public rather than merely fulfilling a formal legal requirement;

    (b) informing members of the interested public how to participate in hearing proceedings, including formal adjudicatory hearings;

    (c) making the relevant technical information available and understandable to the general public;

    (d) Publishing a decision after the hearing, with findings, showing the bases for the decision.

5. Expand the public hearing procedure to include matters not now subject to public scrutiny, such as mining, utility lines, some roads, etc.

6. Insure that hearings go to the basic issue involved and that the hearing is before the agency with the power to decide such issues.

7. Develop massive, well financed public education programs on ecology and on recreation uses of the public lands (motor vehicles, littering, property defacement, camp site maintenance, etc.)

8. Re-evaluate the entire information and education (I & E) function of public land management agencies. Avoid "credibility gaps" by keeping the public fully and fairly informed.

9. Re-examine BLM, Forest Service, Park Service and other management agency "advisory boards" as to role, composition and appointment; consider adding incentives by providing expenses and honoraria.

f. Personnel Alternatives

1. Provide all land management agencies with adequate funding for ecologically qualified scientific staff personnel who are not attached to any special agency project or activity.

2. Institute intensive staff training programs on environmental considerations and alternatives.

3. Include members of other than the traditional disciplines on land management agency staffs (planners, ecologists, geographers, sociologists, psychologists, lawyers, etc.).

4. Consider a system of bonding administrators to ensure appropriate performance.

5. Provide additional personnel to implement and police measures to protect environmental quality.

6. Abandon or revise the agency seniority systems which resist change and preclude some of the most qualified people from decision-making.

g. Funding Alternatives

1. Revise budgeting and funding procedures so as to reflect a policy that all land management decisions are inter-related, rather than capable of allocation to a particular activity (e.g., range, watershed, timber, etc.)

2. Change the practice of allocating funds for particular "projects," and requiring any environmental expenditures to be taken from such project funds.

3. Budget specifically for environmental protection.

h. Agency Mission Alternatives

1. With respect to multiple use agencies, take steps to ensure that traditional functions (logging, protecting livestock interests, dam building) are not emphasized at the expense of environmental values. This may require an added emphasis on and additional financing for environmental values, as well as a retraining of personnel.

i. Environmental Imperative Alternatives

1. Generate an overall public land management policy that development of natural resources should be permitted only when it can be shown that stability of environmental quality can be maintained within reasonable limits.

2. Create a "composite" of experts in government, industry, user groups and the academic community to establish standards for the "maximum allowable limits of deterioration of land and water resources."

3. Consider future as well as present needs of the people, realizing the long-term impact of some activities and the extent to which environmental values may be nonrenewable resources.

4. Conduct each activity so as to minimize the effect upon other resources and values.

5. Recognize the possibility of adapting attitudes and the pace of development so that human use and the natural environment may develop in harmony.

APPENDIX S-1

ROCKY MOUNTAIN CENTER ON ENVIRONMENT
5850 East Jewell Avenue
Denver, Colorado 80222
(303) 757-5439

November 20, 1969

Case Study Design Requirements

STUDY OF PUBLIC LAND POLICY AND THE ENVIRONMENT

Objectives: To provide the Public Land Law Review Commission with information needed to evaluate the adequacy and effectiveness of present laws, regulations, policies, procedures and practices relating to the consideration of environmental and ecological factors in public land use policies and decisions; to examine various alternative courses of action that are or could be available to protect or enhance various environmental values and resources.

Methodology: Approximately 17 cases from a variety of locations will be selected which represent specific environmental problems related to specific uses of public lands. The environmental enhancement or degradation described in the cases may either have happened or is anticipated. Types of problems to be considered include air quality, water quality, ecosystem changes and alterations of scenic, wilderness, wildlife, fishery, historic or outdoor recreation values and resources. Land uses will represent multiple use, timber harvesting, mining, grazing, water development, uses and occupancy, outdoor recreation, oil and gas development, road and highway construction and atomic energy. Each case study will discuss the use or uses in the context of specific environmental problems associated or alleged to be associated therewith.

Point of View: These case studies must be objective and scientifically valid. Attempts to "propagandize" a point of view or to make sweeping generalizations from one or two examples must be avoided. However, it must be recognized that value judgments in a study of this type are necessary as they are unavoidable. This study will make certain value judgments on resources sometimes considered incapable of measurement in traditional economic terms. Individuals making the case reports may assume that maintenance of a quality environment for man is an acceptable objective of public land policy.

Case Study Model: Case study write-ups will be 3,500 to 5,000 words. All write-ups must be typed according to the PLLRC "Guide to Manuscript Typing." The format for each case discussion will be designed to: (a) communicate the problems clearly and precisely; (b) explain how the problem came about; and (c) examine alternatives as to how the problem might be "solved" in the future. The format for each case will be as follows:

1. Recitation of the Facts. What happened? When and where did it happen and under what circumstances? If the case was in the nature of a public controversy, what economic, political, scientific or citizen action forces were involved? What were the "arguments" employed by each side?

. Environmental Impact. What were the environmental and ecological effects of the land-use decision? Precisely, what were the effects on air quality, water quality, wildlife habitat, vegetative patterns, scenic resources, wilderness values, outdoor recreation resources, etc.? What documentation exists as supporting evidence of these effects? Are photographs available? If the land use decision was forestalled or postponed, what were the environmental impacts that were feared or claimed? Were such fears or claims well grounded, in the scientific sense?

. Problem Origins. How did the problem come about? What was the land use that precipitated the problem and what agency permitted it? What laws, regulations, policies, procedures, practices or time-honored customs contributed to the problem? How does the problem relate to the various "publics" being served by the land use?

. Environmental Considerations and Alternatives

a. Considerations. What kinds of environmental and ecological considerations were made by the particular land management agency with respect to actual or prospective environmental impacts of the particular land use? Were there special studies, field investigations, public hearings, coordination with other agencies, etc? Of what nature and extent? What was done, specifically, to avoid or mitigate certain kinds of either proven or suspected environmental impacts?

b. Alternatives. What alternative courses of action may have either (a) avoided the environmental problem(s) altogether, or (b) mitigated the particular environmental impact(s)? What were the obstacles to adopting these courses of action? Were adequate laws, regulations, policies or procedures available for considering such alternatives?

ginal Research: There will not possibly be time, or funds, for any case study
sultant to conduct original fact-finding or research on a case not already well
umented. Thus each case must of necessity consist of reviewing, evaluating and
marizing existing information, studies, and other documentation. Criticism of
earch conducted by others is of course expected, so long as it is scientifically
ective.

ld Trips: Generally, case study consultants will be selected who reside in the
e geographic region as the case study assigned to that consultant. Anyone is
ely to produce a much better case study if he has actually seen the situation on
ground. The first question of case study critics is apt to be: "Did you actually
the area?" Special arrangements will have to be made with the contractor on
Cutting Practice Composite case which involves widely dispersed areas.

erences: A list of references for each case study is mandatory. Obviously, many
ple will want to know where the consultant got his information. Key individuals
ency heads, government officials, conservation leaders, etc.) interviewed should
included as well as documents. A list of "confidential" sources must be submitted
the contractor although it will not be published.

dlines: This study, through no fault of the contractor (Rocky Mountain Center on
ironment), must be completed in a very short period of time. The following dead-
es are mandatory and unalterable:

December 15	Sketch or draft of case study model items 1 through 4(a).
January 9	Completed case study mailed or hand delivered to ROMCOE.
January 9-22	All necessary case study revisions.
January 26	All case study reports delivered by ROMCOE TO PLLRC, Washington, D. C.

Editing and Writing: The final content of each case study report will be the responsibility and product of each case study consultant. While substantive content will not be substantially altered without express consent of the author, the contractor may make suggestions and may edit reports for grammar, structure, spelling and readability. Rewrites will not be undertaken. Case study authors should keep in mind that they are writing for a "lay" commission and other members of the general public rather than for the scientific community. Academic jargon must be avoided as much as possible.

Length of Reports: With several indicated exceptions, case study reports must be 3,500 to 5,000 words or about 15-20 pages typed double space. References, photographs, maps or other graphics are in addition to this length.

Photographs: Photographs to illustrate a particular environmental problem or solution are desirable for all cases and mandatory for some as indicated. Photos should be black and white glossy prints 5 x 7 or 8 x 10. Color photos or slides are not acceptable since they will not be reproducible in the report. However, black and white reproductions from color photos are acceptable. The Forest Service, BLM, Park Service, etc. already have some photos available on request. An attempt should be made to obtain two prints of each photo so that two sets of photos will be available -- one for the Commission and one for ROMCOE. This is not mandatory, however.

APPENDIX S-2

OCKY MOUNTAIN CENTER ON ENVIRONMENT
850 East Jewell Avenue
enver, Colorado 80222
303) 757-5439

November 20, 1969

Case History Descriptions

STUDY OF
PUBLIC LAND POLICY AND THE ENVIRONMENT

ULTIPLE USE

1. Batholith Granitic, Idaho. Peculiar soil conditions in the "Batholith" contribute to a variety of multiple use environmental problems related to grazing, timber harvesting, watershed management, and recreation use. Considerable documentation is available from the Regional Office of the U.S. Forest Service in Ogden, Utah and from the U.S. Geological Survey at the Denver Federal Center. A "Batholith Steering Committee" is also reported to be associated with the Ogden USFS office. Special study emphasis: multiple use planning, total ecosystem impacts and considerations, effects of logging and grazing, salmon fishery impacts, effects of herbicides and pesticides; effects of brush or grassland "controlled burning" if any. Length: 5,000 words.

2. Lake Tahoe, California and Nevada. This case study, using a total ecosystem analysis approach, will examine the multiple environmental impacts of various "multiple" uses of public lands in the Lake Tahoe region with special emphasis on factors contributing to the severe water pollution problems in the lake. Public land laws, regulations, policies or procedures, including leases and sales to private parties, will be examined in relation to their effect on environmental degradation from private development. Small tract purchases near Carson City, for example, are reported to seriously affect deer migrations. Road scars, housing development with resulting lake sedimentation, recreational vehicle impacts, Heavenly Valley and Squaw Valley ski developments, fishery and esthetic impacts will also be examined. Land exchange policies should be given special consideration. Sources: Norman B. Livermore, Resources Director, State of California; Dr. Paul Goldman, Davis Institute of Ecology, California; Mr. McLaren, Lake Tahoe Regional Water Quality Control District. Photos required. Length: 3,500 to 5,000 words.

INING

3. Henderson Project, Colorado. The Climax Molybdenum Company has been cited by several national organizations, including Business Week magazine, for an "Experiment in Ecology" being carried out with the Rocky Mountain Center on Environment and Colorado conservation groups. The vast "Henderson Project" discovery near Empire, Colorado is being developed as a "model" mining operation which will give maximum consideration to air quality, water quality, wildlife habitat, esthetics, public recreation and related values. It involves close relationships between private industry, state government, the U. S.

Forest Service and private citizen organizations. It demonstrates what can be done when land management decisions thoroughly consider environmental and ecological imperatives. Include analysis of electric transmission line and gas service pipeline. Photos desirable. Source: Roger P. Hansen, Executive Director, Rocky Mountain Center on Environment, Denver, Colorado. Length: 3,500 to 5,000 words.

4. Shirley Basin, Wyoming. A BLM representative has termed the environmental impact of uranium mining activity in this area near Casper, Wyoming as "shocking." Mining pits up to 160 acres in size and ranging 50 to 100 feet deep are being opened in profusion, according to reports. Overburden disposal areas may cover additional public land tracts as large as 200 acres. Processing mills, townsites and related facility construction is also underway. Three major companies are now working the area and a fourth is anticipated. Operations are expected to last over a 20-year period. The mining affects grazing, wildlife habitat, water quality, air quality and general ecology of the area. The Medicine Bow and North Platte rivers are involved. Some fear that eventually 50,000 acres of public domain will be "denuded." Source: Bureau of Land Management, Wyoming State Office, Rawlins District. Photos required. Length: 3,500 to 5,000 words.

5. Copper Pit Mining Composite, Arizona. This case will examine the total environmental impact of open pit mining for copper on public lands in Arizona. Emphasis will be on the impacts of this use on vegetation, forage, water resources, wildlife, air quality, esthetics and related resources and values as well as the success or failure of efforts to minimize these impacts. Mined land reclamation efforts will be particularly examined. Areas to be examined:

   a. Sahaurita Area. This area south of Tucson has two open pit projects quite different in character. At the Twin Buttes project of Anaconda Copper Co., 250 million tons of alluvium have been removed to reach the copper deposit. Extensive efforts are being made to revegetate alluvium "dikes" which will form the tailing areas. By contrast, the Duval Corporation's Sierrita Project less than 3 miles away is digging on solid rock where waste disposal is an entirely different problem. For example, leaching is not possible at Twin Buttes but it is being done at Sierrita. Both companies, under vastly different situations, are trying to "engineer" ecology into the projects. Both are new projects.

   b. Miami-Superior-Hayden Area. The Miami Copper mine is a much older operation, commenced before anyone thought reclamation was important. Old dikes provide ugly eyesores. However, some reclamation efforts have been at least partially successful. At the Superior Mine of the Magma Copper Co., tailings have a tendency to be "cement-like" which poses unusual reclamation problems. At Hayden, a Kennecott mine is faced with great tailing instability, blowing, etc.

Approximately a year ago, hearings were held on a withdrawal of 7½ square miles of BLM land for a Smithsonian Astrophysical laboratory 30-40 miles south of Tucson on top of Mt. Hopkins in what, the mining industry claims, is the heart of the most highly mineralized area on the continent. The withdrawal, predictably, was contested unsuccessfully by the mining industry. This incident would bear examination as part of the case study. Sources: Bureau of

Mines and Bureau of Land Management, Washington, D. C.; Ed Peplow, Executive Director, Arizona Mining Association, Phoenix, Arizona. Photos required. Length: 5,000 words.

RAZING

6. South Central Utah. Considerable documentation exists on the total impact of grazing on the ecology of South Central Utah. This involves both BLM and USFS lands and relates to many problems of "overgrazing" common to so much of the Southwest. The case encompasses two adjacent valleys in the Fillmore District, including Pine Valley. Other sources: Forest Service Desert Experiment Station; Robert Nielsen, BLM State Office, Salt Lake City. Special emphasis: relationship to other "overgrazing" problems in Southwest; brush spraying effects; soil conditions where there should be no grazing; effect of lack of "rotation plan" within a grazing allotment. Length: 3,500 to 5,000 words.

ORESTRY PRACTICES

7. Cutting Practice Composite. This case study will examine the esthetic and other ecological impacts of various timber cutting practices, notably "clear cut," "square cut" and "patch cut." The visibility impact from both established roads and highways and back country recreation aspects will be examined. Some value judgments are unavoidable. It is important to examine both "good" and "bad" examples. Availability of photographs to accompany the report is critical for this case study. Evidence of public reaction to cutting practices is important if documentation is available. Robert Saffaran, Supervisor, Teton National Forest, Wyoming is reported as a good source as is Ed Stone, Senior Landscape Architect, U.S. Forest Service, Washington, D. C. and Dr. Marvin Hoover, USFS Experiment Station, Fort Collins, Colorado. The Willamette National Forest in Ogden, The Lewis and Clark National Forest in Montana and Fraser Experimental Forest in Colorado should also be contacted for examples. Optional examples may be selected. Photos required. Length: 3,500 words.

8. Fire Ecology Composite. According to "Smoky the Bear," a forest fire is something to be abhorred and avoided. That anyone of sound mind would purposely "set" a forest fire is incomprehensible to most people. This study will examine the effects of the absence of fire on an ecosystem, including the concept of "controlled burning" as a device of forest and wildlife management, in the context of any three of these four examples:

    a. Case on grassland or brush burning for grazing and its effects. This will be selected by the consultant. Tonto National Forest, Arizona, has been cited.

    b. Elk Habitat, Nez Perce National Forest. The Nez Perce is on the Selway River drainage in southern Idaho. Wildfires of 85 years ago burned off large areas of spruce-fir forest which were succeeded by maples and willows, providing excellent elk habitat. But the spruce-fir is coming back and the maple-willow is getting out of reach. Both controlled burning and herbicides have been used to preserve the elk range. Sources: J. Evert Sanderson, Forest Supervisor, Nez Perce National Forest, Grangeville, (90 miles from Lewiston) Idaho; Thomas Leege, Idaho Fish and Game Commission, Kamish, Idaho.

c. Water Management and Wildlife, Black Hills. The Black Hills National Forest of Wyoming and South Dakota has been used for very intensive timber management. Fire control is extensive. Water management experts are concerned with the "phreatophyte effect" of growing, thickening timber stands on ground water and stream supply. There are also wildlife implications. Source: Supervisor, Black Hills National Forest, Custer, South Dakota.

d. Sequoia National Park, California. The Giant Sequoia is what ecologists call a "fire climax" as it succeeds other vegetation that has been completely destroyed by fire. Certain soil minerals on which the Sequoia depends occur in most abundance in burned out areas. Without fire, the Sequoia would disappear as a species. The National Park Service has been conducting controlled burning in Sequoia National Park since 1967. A similar problem will occur in the recently established Redwood National Park. Source: Dr. Richard J. Hartesveldt, Professor of Biology, San Jose State College, California.

Dr. Harold Biswell, University of California at Berkeley, is reported to have done work on prescribed burning for deer habitat. Game and fish people in Michigan, Idaho, Wyoming and South Dakota should also prove helpful. Substitute examples are acceptable, if approved by ROMCOE. Length: 5,000 words.

9. Pass Creek, Roseburg District in Oregon, Bureau of Land Management. The Pass Creek case presents a problem of "checkerboard" BLM and private ownership on the Unqua River drainage. Timber management is the principle land use with reported damage to fisher, wildlife and watershed values. BLM has been responsible for much of the road building, reputed to be of "poor" design. The local Flycasters' Association has produced a film on detrimental effects to steelhead fishery, resulting in part from thermal effects produced by rises in stream temperature. Special considerations: Compare BLM and USFS road building practices and road design standards in some general area. Sources: George Francis and Archie Draft, Roseburg BLM District, Roseburg, Oregon. Maximum length: 5,000 words.

10. Insect Disease Control Composite. This case will examine the ecological effects of both the presence and the absence of control programs for forest insect infestations on forest resources, other vegetation, wildlife, water quality, fishery and other pertinent environmental values. The "economic effects" on commercial timber stands are not a major consideration of this study although they may be mentioned as appropriate. Suggested examples for analysis, covering a time span from 1850 to the present:

Spruce Bark Beetle, Rabbit Ears Pass, Routt National Forest, Colorado. This was a very severe attack which changed the whole forest ecology from spruce to subalpine fir and spruce, although the forest in this case was not "lost" to the beetle. The epidemic started in 1850.

Spruce Bark Beetle Cut, Rio Grande Grant, Carson National Forest, New Mexico. In this case, certain cutting practices were introduced to "save" the forest. The result was that the whole ecosystem was altered from spruce-fir to grassland. The practice occurred in the late 1950's and early 1960's.

Black Hills National Forest, South Dakota. This spruce bark beetle attack commenced on ponderosa pine in the 1940's. The case involves both extensive "control" programs and absence of control.

Mountain Pine Beetle, Teton National Park and Teton National Forest. This case involves considerable control for "esthetic" effect, particularly in the National Park.

Spruce Bark Beetle, Flat Tops, White River National Forest, Colorado. This infestation was not controlled with the result of thousands of acres of bleached tree skeletons. The area is part of the Flat Tops Primitive Area, proposed as Wilderness. Considerable back country recreation use and watershed.

Other examples: a disease which struck 21 million acres of sagebrush in Oregon, Idaho and Nevada in 1964; the beetleaf hopper problem in Idaho; spruce bug worm problems in the Pacific Northwest. No more than two examples should involve the spruce bark beetle or the spruce bug worm. At least four examples should be used in the case study. Photos required if available from government agencies. Source: Dr. Noel Wygant, retired U. S. Forest Service entomologist and insect control expert, Ft. Collins, Colorado. Length: 5,000 words.

OIL AND GAS DEVELOPMENT

11. Santa Barbara Oil Spill. The Santa Barbara oil incident has been so widely discussed in both popular press and scientific journals that it needs no further description for this case outline. It is an excellent case to discuss in the context of existing and already proposed public land laws, regulations, policies, and procedures. A 90-page discussion paper, including a chronological "log" of the key events leading to the Santa Barbara disaster, was prepared by Malcolm F. Baldwin, Legal Associate, The Conservation Foundation, for a "Conference on Law and the Environment" held at Arlie House, Warrenton, Va., September 11-12, 1969. The major problem for the author of this case study will be to boil down all the relevant available data. Photos optional. Length: 5,000 words.

HIGHWAY CONSTRUCTION OR IMPROVEMENT

12. Wheeler National Wildlife Refuge, Alabama. This is another "squeeze play" case. The Wheeler Refuge is located on a TVA impoundment. An interstate highway between Huntsville and Decatur will bisect the Refuge. A goose and duck wintering area. The matter has progressed too far, with major construction completed, to "save" the Refuge. Typically, the Bureau of Sport Fisheries and Wildlife was not "coordinated" with the Bureau of Public Roads until it was too late. Source: Robert Scott, Chief, Division of Wildlife Refuges, Bureau of Sport Fisheries and Wildlife, Washington, D C. Photos desirable. Length: 3,500 to 5,000 words.

PRIVATE POWER DEVELOPMENT

13. High Mountain Sheep Dam, Snake River, Idaho. This involves the application by a consortium of Northwest private power companies to the Federal Power Commission for a license to develop High Mountain Sheep dam and other hydroelectric power facilities on the Snake River in Idaho. The proposal has

generated bitter controversy and has resulted in a precedent-setting U. S. Supreme Court opinion on power development and ecological values. The matter is extremely complex and as yet unresolved. Special considerations: "quality" recreation, wildlife, fishery, relationship to other Snake River developments, political and social contexts. Source: The Rocky Mountain Center on Environment has a thick file on the controversy. Maximum length: 5,000 words.

RECREATION USER IMPACT

14. Boundary Waters Canoe Area, Minnesota. Established as a Wilderness by the Wilderness Act of 1964, Boundary Water has 25% of the total national Wilderness visitations for the entire Wilderness Preservation System. What is the impact of these 880,000 annual visitor days? How are these impacts being accommodated? The "quality recreation experience" dimension is important in this case. Water pollution from mass recreation use is a major problem. So is access. Two federal court cases have been decided in favor of the government's right to control access: Perkoe v. U. S. and Macky v. U. S. Recreation use is being regulated in the area, with what results? Boundary Waters is also the only federal recreation area that controls minimum aircraft altitudes. Sources: Dr. Michael Barton, Liminologist, U. S Forest Service, Superior National Forest, Duluth, Minnesota, Walter Hopkins, Recreation Research, U. S. Forest Service, Washington, D C ; Richard Costley and Larry Neff, Recreation Specialists, U. S. Forest Service, Washington, D C Photos desirable. Length: 3,500 to 5,000 words.

15. Yosemite Valley, Yosemite National Park, California. Yosemite probably has more of more kinds of recreation impact than any park in the National Park System. Hordes of Californians have literally been beating the area to death, winter and summer. The Park Service has instituted many new management policies: Establishment of one-way roads; limitations on campground occupancy; new facility design criteria; cancellation of the famous "firefall,"; etc. Park Service specialists in sociology (Neil Cheeks), traffic control, and enforcement procedures have made special studies. Studies are also available from several sources at the University of California at Berkeley. Source: Larry Hadley, Superintendent, Yosemite National Park. Photos required. Length: 3,500 to 5,000 words.

16. Recreational Vehicle Impact Composite. With the exception of snowmobile problems, Russell Penny, California State Director, Bureau of Land Management, can select all of the examples for this case study that relate to 4-wheel drive vehicles, dune buggies, trail bikes, motorcycles and similar contrivances. Special areas suggested: Mojave and Sonoran Deserts and Panoche Hills near Bakersfield. Possible sources for data on snowmobiles: Colorado Division of Game, Fish & Parks, Harry Woodward, Director; Dave Nordwall, Regional Forester, Denver Federal Center, Denver, Colorado; Supervisor, Huron National Forest, Cadillac, Michigan; Supervisor, Superior National Forest, Duluth, Minnesota. Photos required. Length: 3,500 to 5,000 words.

USE AND OCCUPANCY

17. Transmission Line Composite. This case will examine primarily the esthetic impact of transmission line design, construction and location on the public lands. It is important that both "bad" and "good" examples be selected, with

accompanying photographs, recognizing that the utility industry has been experimenting with different designs, colors, conductor materials, right-of-way clearing practices, etc. in an effort to minimize this impact. The U. S. Forest Service landscape architects and perhaps other agencies have been active. Esthetic impacts of transmission lines is a considerable concern of citizens and various conservation groups. Suggested examples: Bonneville Power Co. line near Jackson, Wyoming on the Teton National Forest, with both "good" and "bad" examples. Teton Forest Supervisor, Robert Saffaran, is reported to have photographs available; the Wallaw-Whitman National Forest, Baker, Oregon, is reported to have photographs of "good" examples; both "good" and "bad" examples can be noted from Public Service Company of Colorado lines near Georgetown. The consultant may use other examples providing they are agreed to by the contractor. Another source: Ed Stone, Senior Landscape Architect, U. S. Forest Service, Washington, D. C. Photos required. Length: 3,500 to 5,000 words.

CHAPTER I

RECITATION OF THE FACTS

Introduction

Exposed in over 16,000 square miles of Central Idaho and adjacent parts of Montana, the Idaho Batholith 1/ is the largest granitic intrusion in the United States. This mountainous land mass contains most of the headwaters and upper tributary drainages of the Snake, Salmon and Clearwater rivers in Idaho and the Clark Fork and Big Hole rivers in Montana. (Fig. I-1) Physically, the area is characterized by a preponderance of moderate to steep slopes, streams and rivers in deep canyons, heavy forest stands in its wetter northern and southwestern sections, and significant grazing areas in the drier southern and southeastern portions. (Figs. I-2 & I-3). The area includes a number of significant mineral deposits and streams containing most of the spawning and rearing area for the steelhead and salmon fisheries of the Columbia River.

Almost all of the Batholith area is on federal land administered by the United States Forest Service (Fig. I-4) with jurisdiction divided between Region 1 at Missoula, Montana and Region 4 at Ogden, Utah. The 250 X 90 mile Batholith constitutes parts of 12 national forests. On its periphery are small segments managed by the Bureau of Land Management (BLM) and scattered in the area are parcels of State of Idaho land and a few private holdings. The Bureau of Reclamation and several other federal agencies also have minor interests in the Batholith.

In the past it was the practice to regard the Batholith as a relatively homogeneous unit and early management practices evolved from this assumption. Fragmented studies in various portions of the Batholith over the past thirty-five years have noted great differences in its geology, mineralogy, land form history, soils and soil stability properties,

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1/ Batholiths are large, deepseated masses of granite-like igneous rocks extending over hundreds of square miles, often forming the substructure of mountain ranges. The molten igneous materials are intruded and then cooled slowly at great depths. Subsequently, the batholith mass is uplifted and exposed after overlying formations have been eroded away. The boundary used to delimit the Idaho Batholith is based on a composite approach from geology and soils. Some border zones (modified granitics adjacent to the geologically defined Batholith) are included where physical properties closely resemble those of the major granitic mass. The Kaniksu Batholith in northern Idaho and Canada is not included because of the scale of this project.

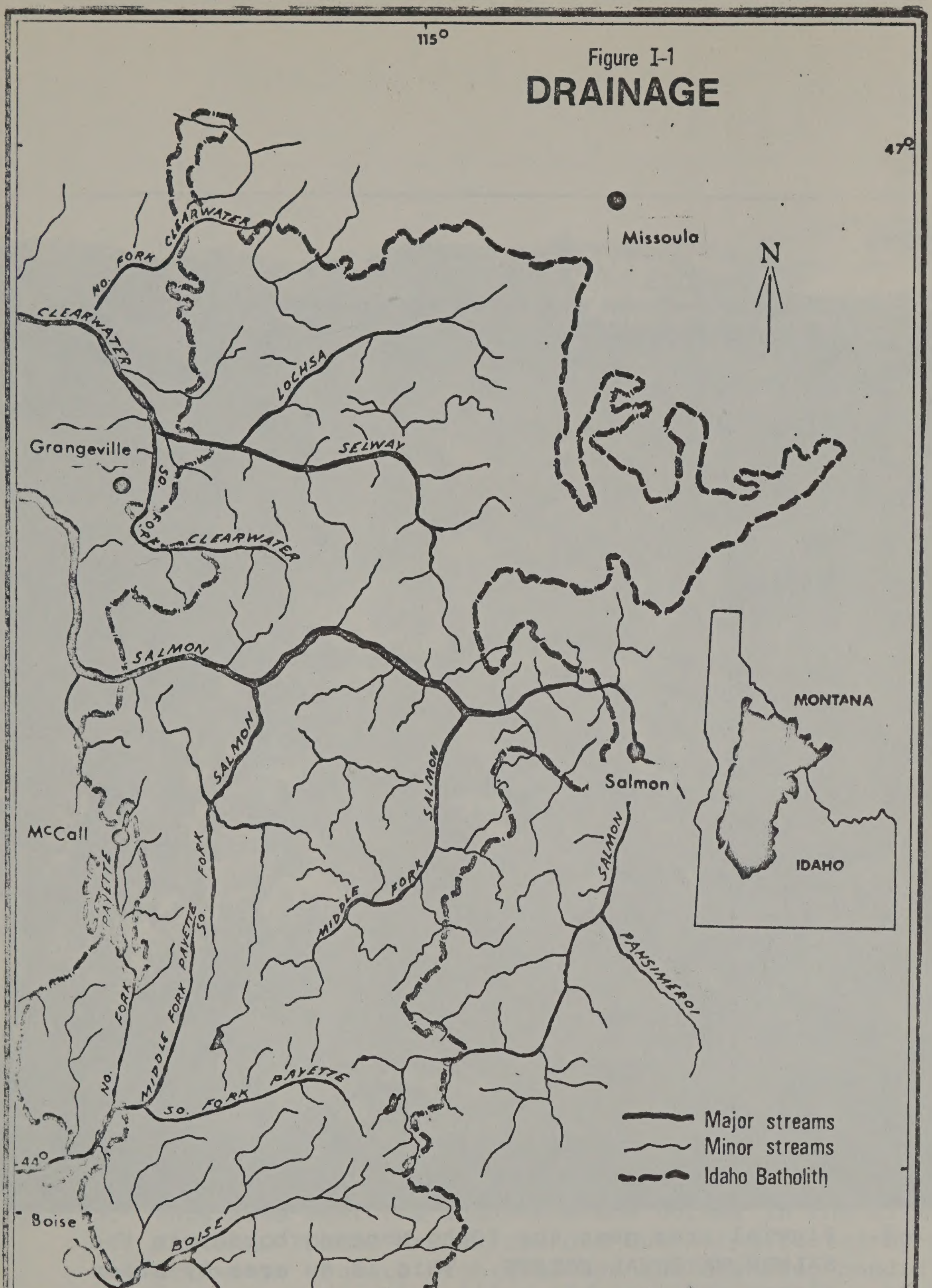

Fig. I-1. Map showing drainage in IDAHO BATHOLITH.

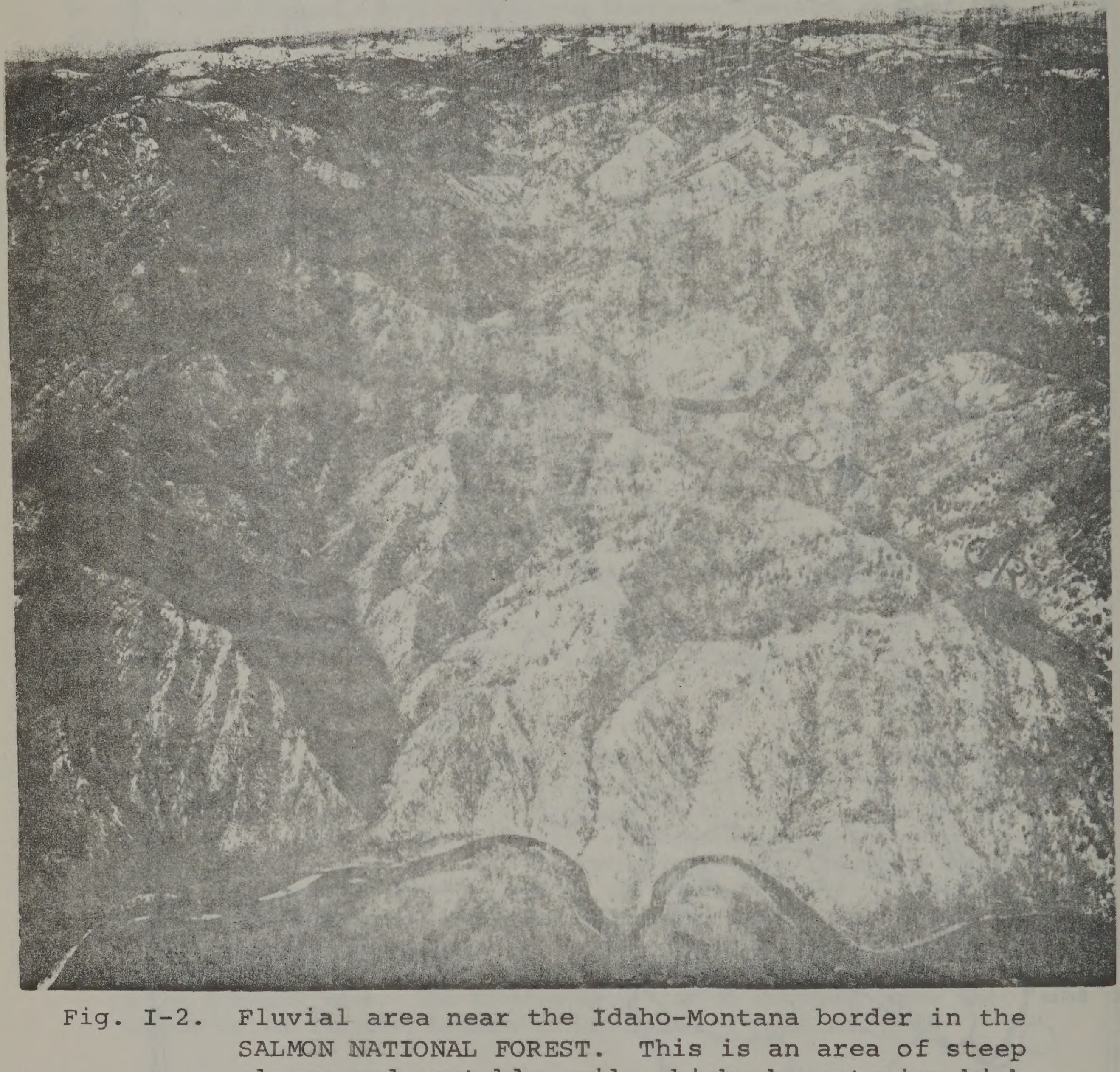

Fig. I-2. Fluvial area near the Idaho-Montana border in the SALMON NATIONAL FOREST. This is an area of steep slopes and unstable soils which characterize high potential erosion. (Courtesy of U.S. Forest Service, Region 1)

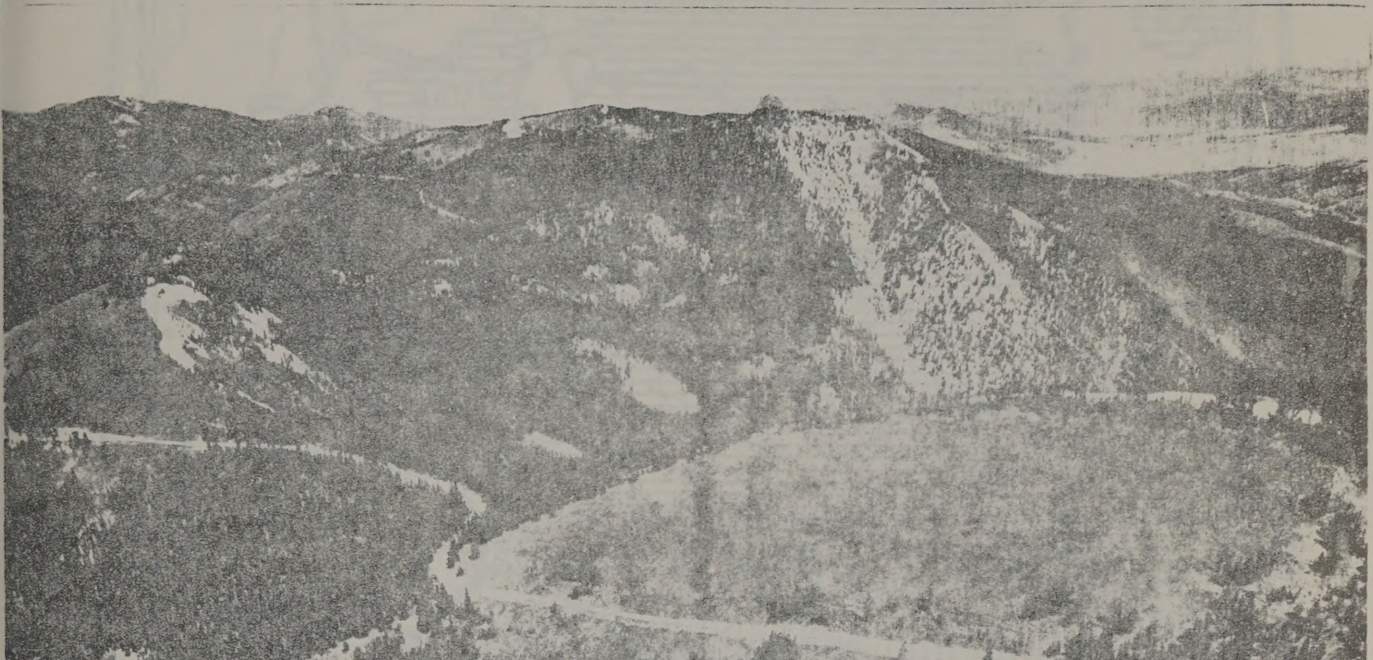

Fig. I-3. This area near the Idaho-Montana border in the BITTERROOT NATIONAL FOREST was surrounded but not affected by glacial activity. Due to high altitude the climatic conditions closely approximate glacial conditions making soils in in these areas relatively stable. (Courtesy of U.S. Forest Service, Region 1)

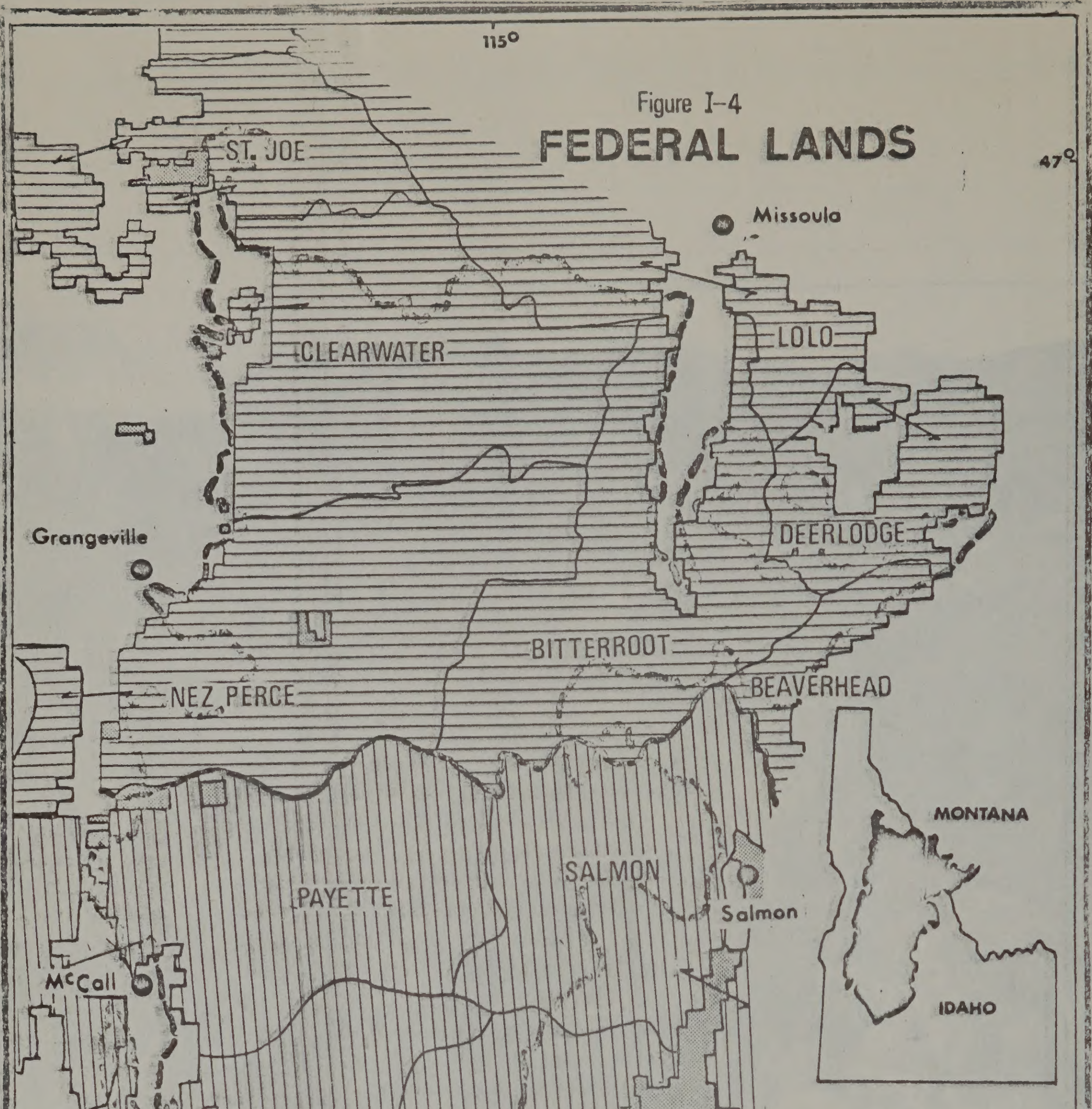

Fig. I-4. Map showing Federal lands and BATHOLITH.

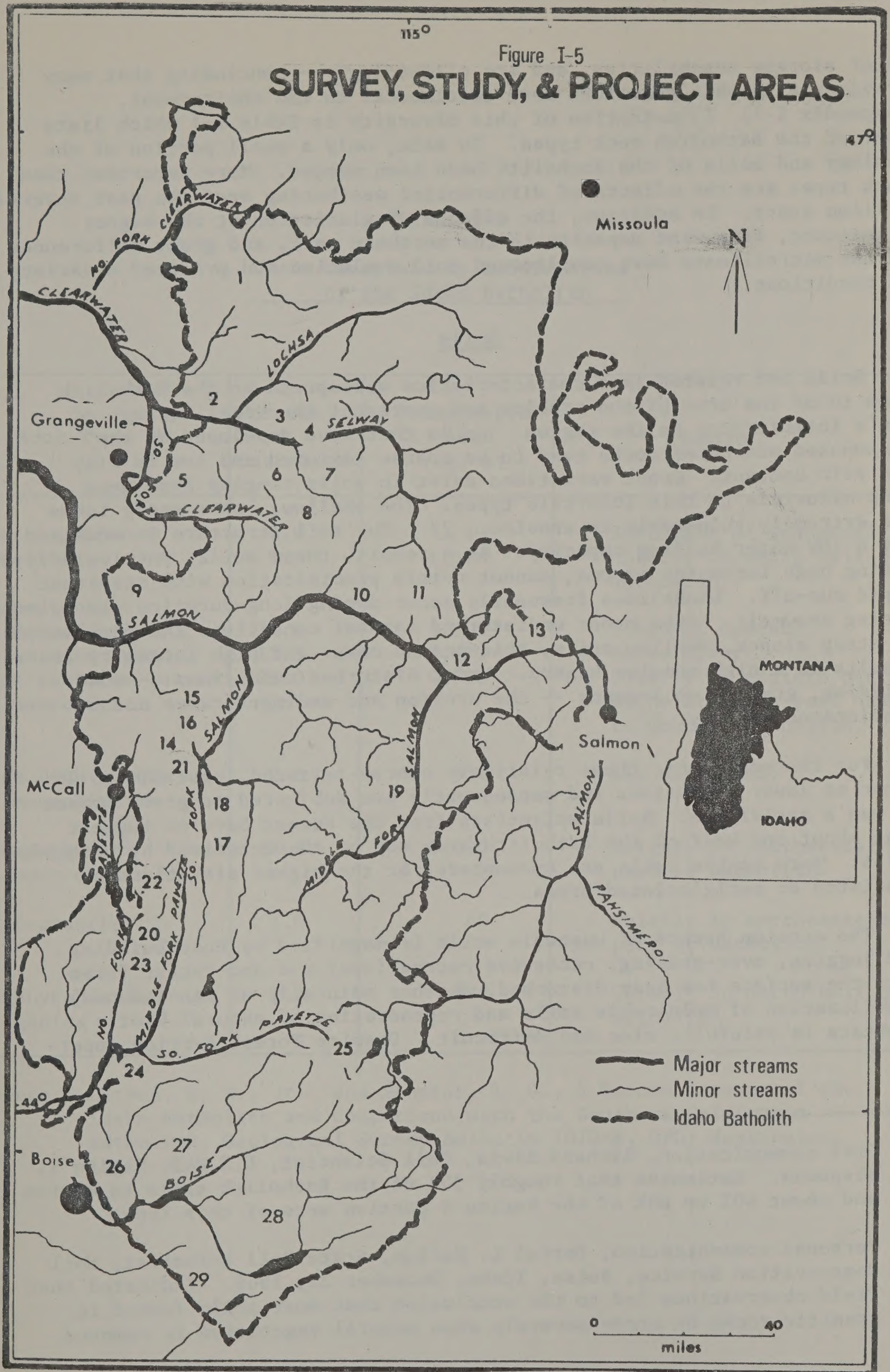

Fig. I-5. Map showing survey, study and project areas in the IDAHO BATHOLITH.

water storage capabilities, and its climatology -- concluding that many previous allowable practices were detrimental to the environment. (Appendix I-1) Illustrative of this diversity is Table I-1 which lists some of the Batholith rock types. To date, only a small portion of the geology and soils of the Batholith have been mapped. More important than rock types are the effects of differential weathering over the past several million years. In addition, the effects of glaciation at the higher elevations, fine wind deposits in the northern part, and great differences in the microclimate have complicated soil evolution and produced a variety of conditions.

Soils

Soils and related land characteristics widespread in the Batholith seem to be the crux of the problem and represent the vital linkage of man's interference in the region. Soils that have developed on the decomposed weathered rocks tend to be coarse textured and low in clay and silt content. Great variations exist in soils ranging from deep rich alluvials to thin infertile types. The shallow, loose sandy loams are extremely vulnerable to erosion. 2/ The soil structure is weak and has a low water holding capacity. As a result, these soils, particularly during high intensity storms, cannot retain precipitation with resultant rapid run-off. Landslides frequently occur during long-duration storms or during snowmelt. Even under undisturbed natural conditions the combination of steep slopes, shallow soils, thin ground cover and high intensity storms results in a high erosion hazard. Under disturbed conditions -- road building, grazing or logging -- the erosion and sediment rates are accelerated rapidly. 3/

For the most part, these relatively coarse-textured, unstable soils occur at lower elevations and consequently are subjected to great impact by man's activities. Soils scientists from the Forest Service suggest that about one half of the Batholith area may be characterized by unstable soils. More stable soils are encountered at the higher elevations on glaciated or periglaciated areas.

The erosion hazard of unstable soils is magnified by road building and logging, over-grazing, excessive recreational use and forest fires. Once the surface has been disturbed, whether naturally or man-induced, stabilization of vulnerable soils and regeneration of natural biotic habitats is painfully slow and difficult. Despite Forest Service super-

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2/ Oral communication, Richard Alvis, Soil Scientist, U.S.F.S. Region 1, Missoula. Estimates that roughly 30% of the Batholith soils in Region 1 and about 40% to 60% of the Region 4 portion were of this type.

3/ Personal communication, Darrel L. Gallup, State Soil Scientist, Soil Conservation Service, Boise, Idaho, December 22, 1969. Indicated that field observations led to the conclusion that most soils formed in granitic rocks do erode severely when natural vegetation is removed.

TABLE I-1

Areas Underlain by Subdivisions of the Idaho Batholith

Rock Type	Percent of Batholith	Estimated Area (sq. mi.)	Remarks
Quartz gabbro	1.0	40	Northeast of Grangeville.
Tonalite	9.0	1,500	Chiefly in north half of batholith.
Granodiorite:			
Cascade type	11.0	1,800	South of Cascade.
Atlanta type	12.5	2,000	Boise River.
Fine-textured quartz monzonite.	25.0	4,000	Chiefly in eastern part of batholith. In part belongs to younger batholith.
Fine dark quartz monzonite.	2.0	300	Elk City area.
Coarse quartz monzonite	37.5	6,000	Chiefly in southwestern part of batholith.
Microgranite	1.0	40	Chiefly in northeastern part of batholith.
Porphyroblastic gneiss	2.5	400	Chiefly in north half of batholith.

Source: Larsen, E. S., Jr., and Schmidt, R. G., A Reconnaissance of the Idaho Batholith and Comparison with the Southern California Batholith, Geological Survey Bulletin 1070-A, GPO; Washington, 1958, p.4

vision, decades of indiscriminate overgrazing and roadbuilding malpractices have irreparably marred the pristine Batholith landscape. There has been minimal concern with environmental impact. This lack led to present problems. Although individuals in the Forest Service have demonstrated concern, agency practices as a whole do not reflect it.

CHAPTER II

ENVIRONMENTAL IMPACTS

The Idaho Batholith is rich in several significant resources including timber reserves, grasslands, surface water supplies, fish spawning grounds, recreation facilities, and natural and legislated wilderness areas. Until the recent past there has been a tendency on the part of land managers and land users to underestimate the ramifications of soils and environmental disturbance. Any one misuse of the land may and often does import serious and subsequent deterioration to other aspects of the natural ecology. The following discussion relates the more important Batholith problems to contemporary management.

Roads

Road building and location has had more impact on the natural ecology of the Batholith than any other single activity. Roads, and especially logging roads, within granitic areas induce and accelerate erosion more than any other single use and represent a "more efficient source" of stream sediment than logged or overgrazed areas. 4/ Table II-1 lists and contrasts the elements of natural sedimentation with those of disturbed or accelerated causes taken from a special purpose survey in the South Fork Salmon River area. It reveals that logging roads, both surface erosion and debris slides, account for nearly one half the total annual sediment production, and that all roads, main roads and logging roads, generate over 60% of all the sediment materials.

The cutting and filling of roads exposes raw mineral soils, interrupts surface and subsurface water flows, and contributes to highly exaggerated rates of erosion. Fill slopes are by far the greatest contributors to the erosion process, as exemplified by Figs. II-1 and II-2. A more detailed breakdown of main road-produced erosion taken from the South Fork of the Salmon River 5/ is:

4/ Megahan, Walter F., Analysis of Four Selected Problems, U.S.F.S. Research, Intermountain Forest and Range Experiment Station, FS-INT-1602, Boise, Idaho, June, 1969, pp. 56-57; and Packer, Paul E. and Haupt, Harold F., The Influence of Roads on Water Quality Characteristics, reprinted from Proceedings, Society of American Foresters, Detroit, Michigan, 1965 p. 112.

5/ Arnold, John F., and Lundeen, Lloyd J. South Fork Salmon River Survey Soils and Hydrology, U.S.F.S. R-4, January, 1968, p. 117.

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TABLE II-1

Estimated Annual Sediment Production From Various Sources in The South Fork Salmon Survey Area.

		Contributing Sources	Total Annual Sediment Production (cubic yards)
Natural	1.	Mountain Slopes	12,150
	2.	Stream Channel Cutting (Depositional Lands)	9,600
		Total Natural	21,750
Accelerated	3.	Main Roads	
		Surface Erosion	10,000
		Debris Slides	5,000
	4.	Logging Roads	
		Surface Erosion	35,000
		Debris Slides	10,000
	5.	Skid Trails	4,000
	6.	Logging Only	3,000
	7.	Livestock-Grazing and Trailing	1,000
	8.	Fire	250
	9.	Wildlife	(Trace)
	10.	Poverty Flat Burn Rehabilitation	2,000
	11.	Other	(Unknown)
		Total Accelerated	70,250+
		Grand Total	92,000+

Sources: Arnold, John F., and Lundeen, South Fork Salmon River Special Survey - Soils and Hydrology, U.S.F.S., R-4, January, 1968, p. 147.

Lundeen, Lloyd J., South Fork Salmon River Special Survey - Stabilization Survey, U.S.F.S. - R-4, June, 1968, p.4

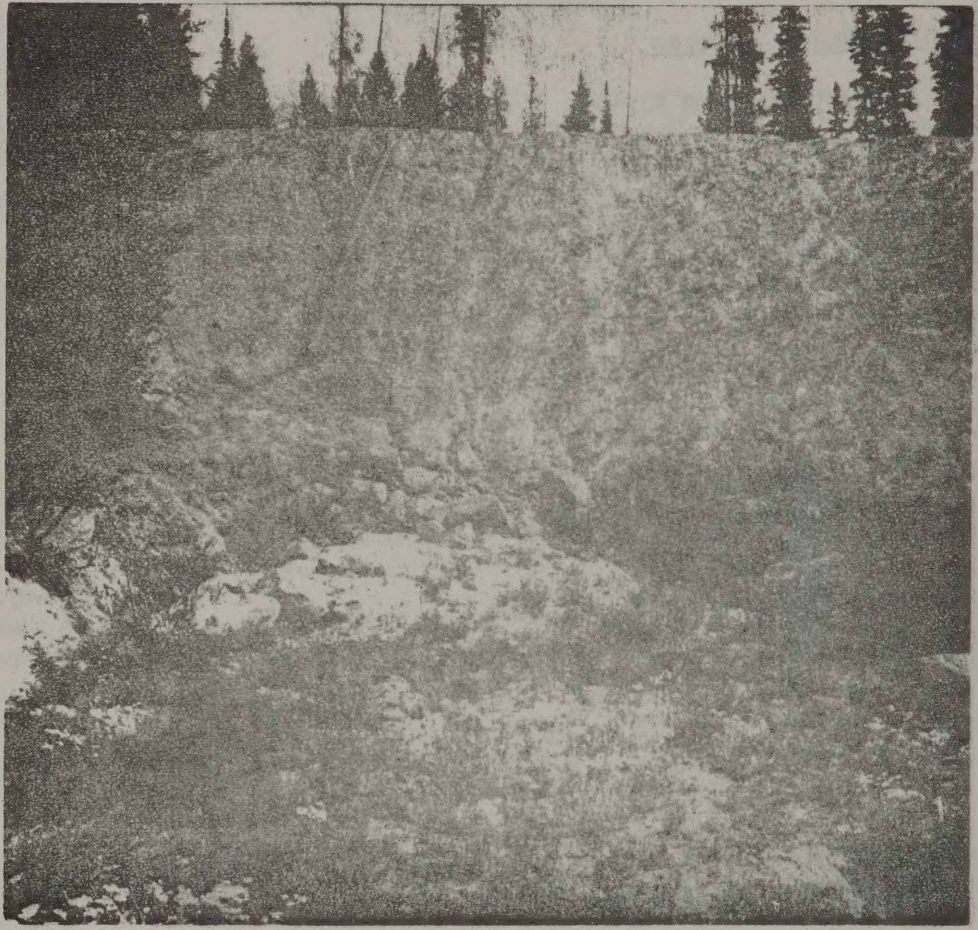

Fig. II-1. TRAIL CREEK. This road is 50 to 60 feet long, poorly stabilized, poorly drained. The culverts are improperly placed. This fill failed several times during and after construction. No attempt was made to clean up the lost material from the channel area below the road or from Trail Creek, just off the picture. Estimated 500 to 1000 cubic yards of sediment entered Trail Creek from this fill. (Courtesy of U.S. Forest Service, Region 1)

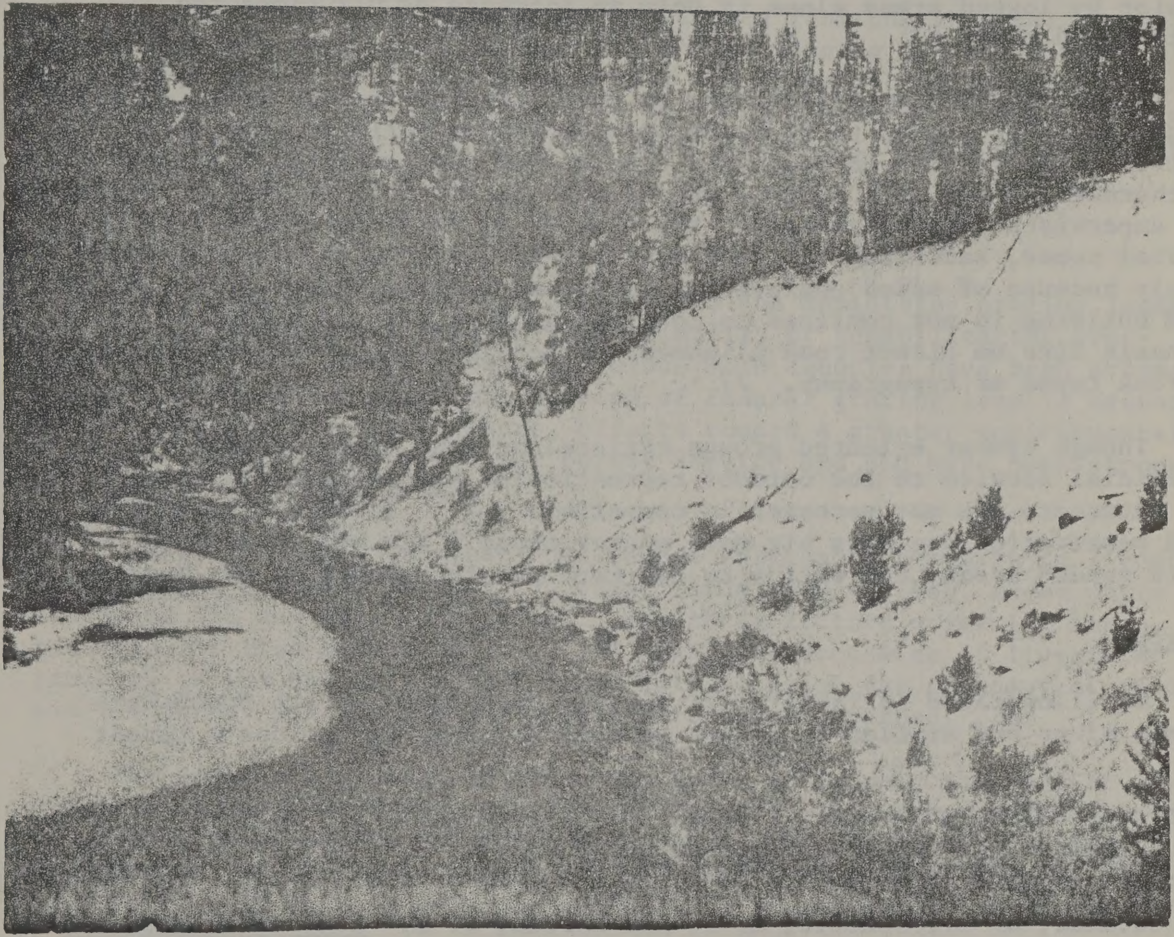

Fig. II-2. The South Fork SALMON RIVER above Dime Creek. Direct road encroachment and constant movement of fill and maintenance waste materials into the channel along the right bank is a major source of sedimentation. The large sandbar along the left bank exemplifies the result of sediment production in excess of the river's cleansing capacity. (Courtesy of U.S. Forest Service, Region 4)

Fill slopes	62%
Maintenance wasting of cut slope material	21%
Cut slopes and ditch	10%
Road surface	4%

The role of roads as an accessory to the erosion process is particularly acute during and immediately following construction and before the cut and fill embankments can settle and a vegetation cover is established. One study estimated that erosion per unit area brought about by road construction is about 940 times the undisturbed rate whereas erosion by logged areas alone is only an increase of 0.7 times the undisturbed rate. 6/

Forest Service specifications on road construction are detailed and exact, but they appear to be based more on safety, utility, and fire control criteria than on potential erosion and sedimentation hazards. Furthermore, there is a serious question as to how well these specifications are supervised and implemented. The Zena Creek Study concluded that in fluvial zones, sacrifices in road quality and design must not be tolerated solely because of added engineering costs and limited budgets. Too often road building is not confined to low road grades, and too often the emphasis lies on direct road alignment rather than attempting to conform to rock types or topography. 7/

Though timber oriented groups rationalize that roads provide a beneficial service to the outdoor recreationist and the hunter, these two interests are not necessarily compatible. 8/ In some instances road penetration destroys big game winter range. Elk will generally avoid roaded areas, retreating to the more remote reaches of the interior. 9/

Logging

As illustrated in Table II-1, logging operations on the South Fork Salmon River and similar lands *per se* does not pose as serious a threat

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6/ Megahan, June, 1969, *op. cit.*, pp. 18-19

7/ Gardner, R. B.; Gonsoir, M. J. and Martin, G. L. *Zena Creek Road and Logging System Investigation*, Department of Civil Engineering and Engineering Mechanics, Montana State University, Mozeman, Montana, September, 1969, p. 24; see "Road Construction Specification." pp. 108-119.

8/ Selke, George A., et al. *Report of the Magruder Corridor Review* Committee, submitted to the Secretary of Agriculture, April 17, 1967.

9/ Personal interviews with Stuart Murrell, Idaho State Fish and Game, Lewiston, Idaho, December 4, 1969; and Dr. Philip Fowler, College of Mines, University of Idaho, December 23, 1969.

to forest environment as does road construction. Some damage cannot be avoided due to the disruption of the forest floor by the movement of heavy equipment, the felling of timber and the skidding of logs. Logging to date in the Batholith includes as a necessary circumstance numerous access roads and a dense network of skidding trails. Most logging damage, irrespective of roads, is attributed to the compaction of soils and soil cuts associated with skidding activities. Skidding trails alone average 25% of an area logged by tractors. 10/

As a rule little watershed damage accrues from the physical removal of timber. 11/ More critical than the actual logging is the location of the logging activity in relation to soil and slope. Logging should not be permitted on shallow soils located on steep slopes or in areas proximate to streams where the introduction of sediments might render undue damage to the stream system.

Grazing

The Forest Service and the BLM oversee and administer grazing lands, and both have faced the awesome responsibility of rehabilitating overgrazed areas within the Batholith. Since both agencies have been attempting to curb overuses and since the leasing of Federal grazing land is essential to many private livestock owners, efforts toward a greater environmental consideration on the part of the Forest Service and BLM have been strongly resisted by livestock groups.

Within the Batholith there has been a noticeable decrease in livestock units during the past twenty-five years; from 1940 to 1966, sheep units decreased 56% and cattle units 20%. The three factors primarily responsible for this reduction are: (1) marginal economies of livestock ranching in the Batholith; (2) range deterioration due to heavy stocking; and (3) Forest Service and BLM pressure to reduce overuse. 12/

The general condition of the range today is roughly the same or slightly worse than in the past several decades. One range investigation of several areas within the Boise River watershed showed only minimal improvements in protected areas. 13/ In terms of grazing capacities, 45%

10/ Steinbrenner, E. C. "Logging on Watersheds: What Type, Where, What Disturbance?" Symposium: Practical Aspects of Watershed Management, Society of American Foresters and Oregon State University, Corvallis, 1966, p. 109-115.

11/ Jensen, Finn, Frank and Larry, Hydrologic Analysis of the Zena Creek Logging Study Area, U.S.F.S., 1966, p. 59; and, Curtis, J. D., Silvicultural Limitations of Shallow Soils, Misc. Pub. No. 24, INT F&RES, U.S.F.S., 1961, pp. 1-4.

12/ Arnold, John F., and Lewis, Monte E. Present Knowledge of the Idaho Batholith, Inservice U.S.F.S. publication, May, 1967, p. 38.

13/ Smith, Justin, Notes on Plots Established in Boise River Drainage, Intermountain Forest and Range Experiment Station, U.S.F.S., December, 1956.

of the total Boise River watershed is in unsatisfactory condition, which includes 90% of all grazable land in that area. Even with some regeneration of ground cover, the deteriorating soil quality will require years to recover. 14/ Figures II-3 to II-8 illustrate some of the grazing damage in this region and provide evidence that livestock overuse has contributed significantly to erosion.

Trampling by hoofs and overgrazing reduces the ground cover, with substantial deleterious effects. Excessive grazing during the growing season not only means the depletion of forage supplies but, also may kill and eliminate the dense mass of fibrous roots instrumental to erosion retardation. The effect of big game grazing is difficult to appraise, but it is certainly negligible compared to the impact of other land uses.

Mining

Few mineral deposits are in the Batholith granitics and most mineralization occurs in the metamorphized border zones. In retrospect mining has had relatively little affect on the environment of the Batholith. A patented dredge mining operation was initiated in Bear Valley in 1955 following passage of the Idaho Dredge Mining Law to extract columbian-tantalum minerals. It continued for about five years. Settling ponds built to hold silt generated by the operation burst during the high-water season in 1969 and resulted in the destruction of aquatic habitats. 15/

There have been reports of bulldozer-exploration or bulldozer-mining in Roaring Valley in the Boise National Forest, in Garden Valley in the Payette National Forest and in the Indianola District in the Salmon National Forest. 16/ In the Indianola District, prospectors utilizing large bulldozers have trenched and criss-crossed an area 10 X 15 miles, destroying many of the grassland meadows. Ranchers are incensed because of the damage to their alloted grazing areas. According to one mineral authority, much of this destruction was completely unnecessary if geochemical techniques had been employed. 17/ In all of the above cases, water quality has been damaged.

Insecticides

Insecticides, namely DDT and Zectran, have been used in the Batholith in an effort to control detrimental effects of the spruce budworm and douglas fir beetle. There are numerous examples of insecticide applications within several National Forests; however, some were conducted on an experimental basis and in others spraying was carried out in rather small-scale operations. There is no evidence that the use of these sprays has significantly affected the forest and stream habitats. In fact, most

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14/ Arnold and Lewis, op. cit., p. 36

15/ Confidential Source II-1

16/ Confidential Source II-2

17/ Confidential Source II-3

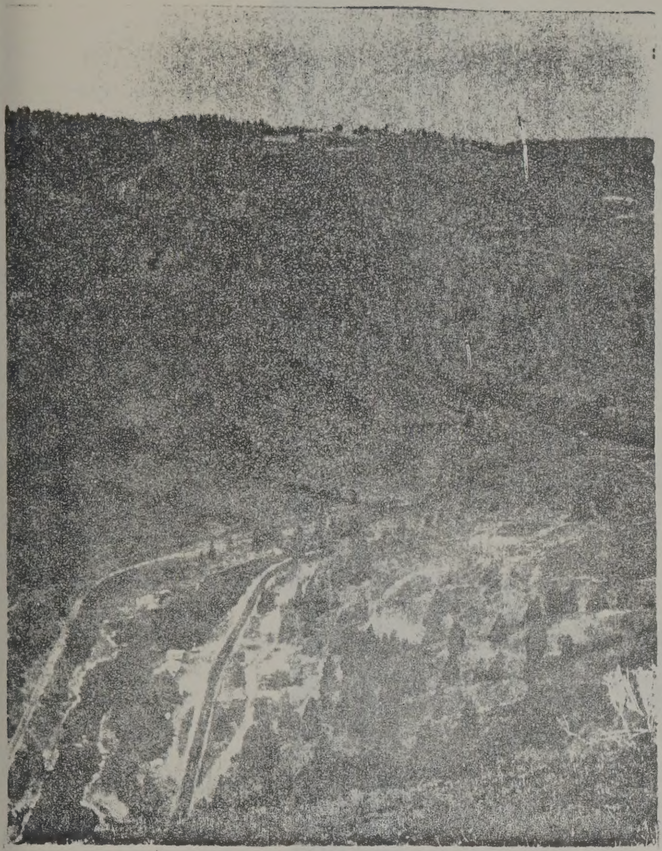

Fig. II-3. JERUSALEM AREA and State Highway 15 along the Payette River. Extremely steep slopes with fragile soils have been subjected to intense rainstorms with overgrazing as a major erosional factor. (Courtesy of Bureau of Land Management)

Fig. II-4. JERUSALEM AREA. A close-up of a section of the road above. Severe erosion caused by heavy runoff has resulted in constant road maintenance to keep the road and ditches free of debris. (Courtesy of Bureau of Land Management)

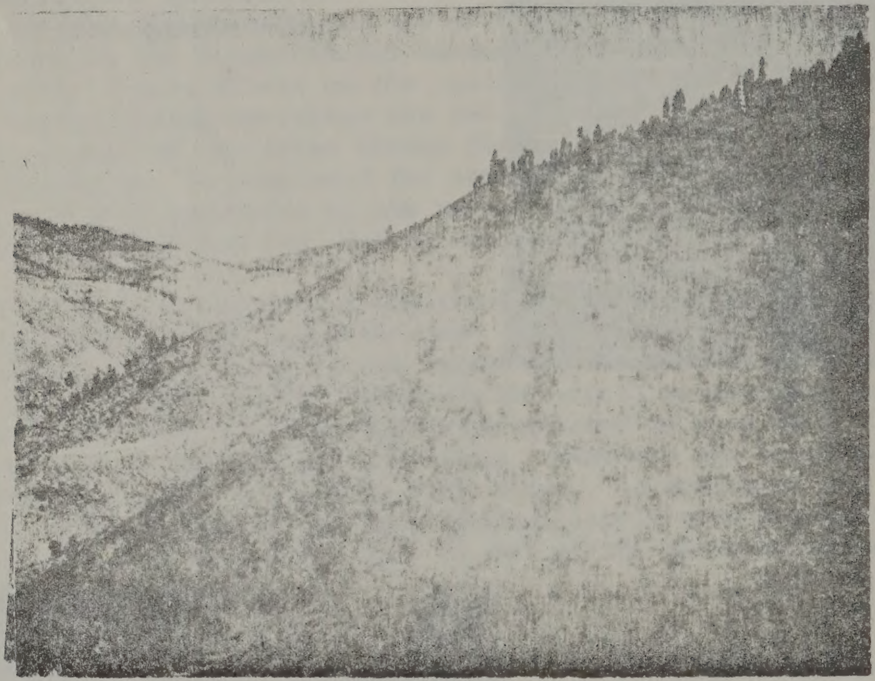

Fig. II-5. JERUSALEM AREA. These terraces have been caused by an excessive number of animal units grazing on steep unstable slopes. This is not to be associated with the conservation practice of contour trenching. (Courtesy of Bureau of Land Management)

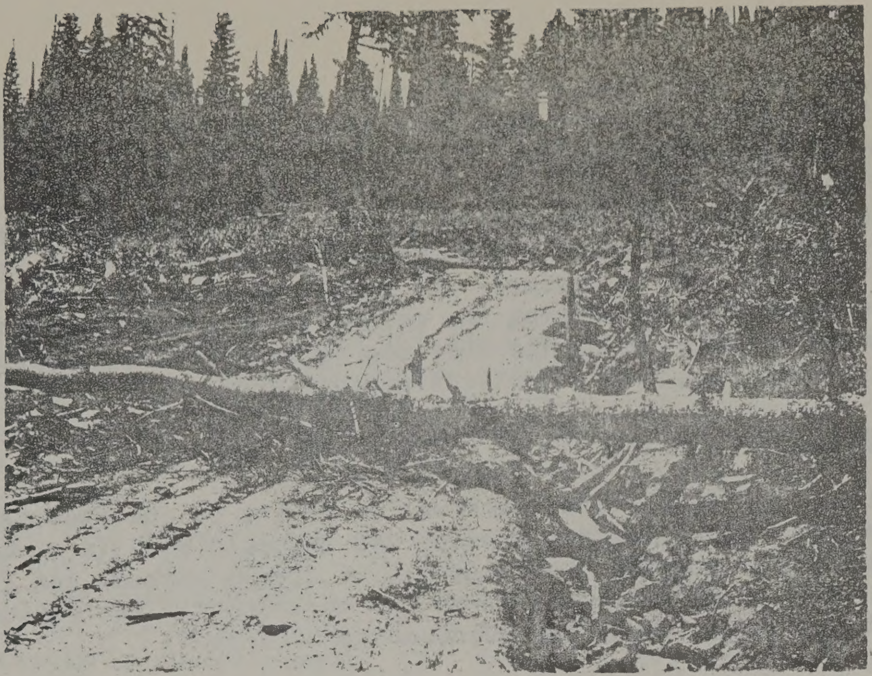

Fig. II-6. JERUSALEM AREA. Undercover regeneration is very poor with unpalatable plants like Western Rudbeckia and thistle replacing forage. This area is adjacent to a meadow and overgrazing has prohibited natural reforestation and caused accelerated erosion. (Courtesy of Bureau of Land Management)

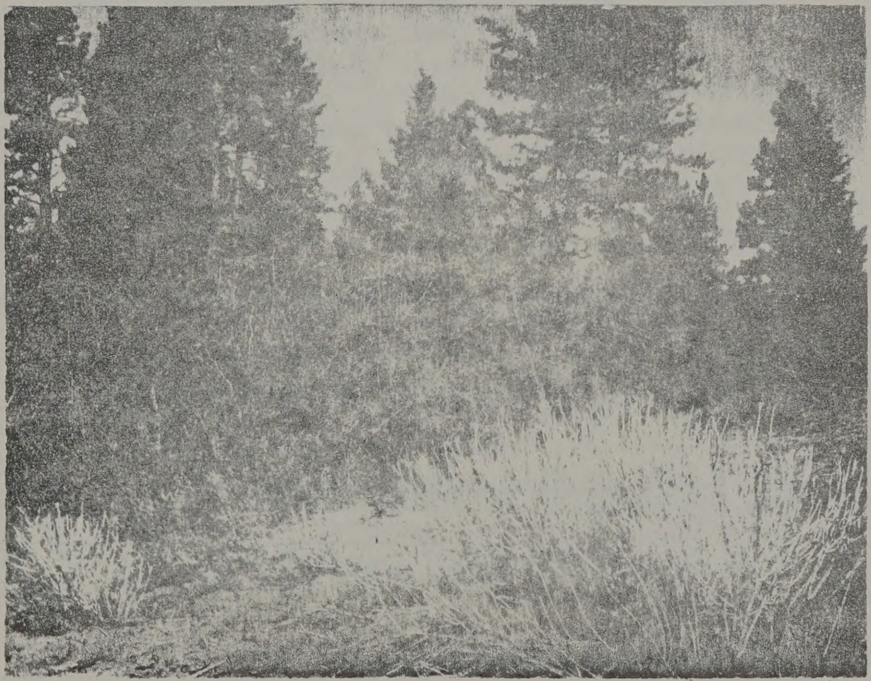

Fig. II-7. JERUSALEM AREA. Heavy grazing pressure has resulted in the growth and browsing of Rabbit Brush, a shrub not normally grazed or considered edible. (Courtesy of Bureau of Land Management)

applications have been strictly monitored, often in full cooperation with the Idaho State Fish and Game Department and the Idaho State Department of Agriculture. 18/

Decisions to utilize insecticides appear to be entirely in-service decisions, with little or no consultation from other agencies. It seems that once the decision is reached, the Forest Service then solicits outside assistance in monitoring the project. This solicitation seems to be done to satisfy the public that the Forest Service is cooperating with many organizations on a decision-making level.

Stream Conditions

The total detrimental and destructive impact of the factors listed above (road building, logging, grazing and insecticides) is nowhere better illustrated than in the condition of stream systems and fishing resources. The characteristics of stream environments are virtually determined by the nature of the surrounding watershed.

Aside from being an important water source area for the Columbia River, the Batholith contains the principal spawning and rearing water for steelhead trout and chinook salmon in the Columbia River system. An estimated 29% of all fish entering the Columbia River originate in Idaho, mostly in streams within the Batholith. The West Coast Cutthroat Trout, a rare and endangered species, spawns only at five-year intervals. Many of these trout are located in the Selway River system, one of the few healthy habitats inhabited by this fish. It should be noted that the Selway River is more important for anadromous spawning grounds. 19/

Many stream systems within the Batholith have been severely damaged esthetically and aquatically in the last couple of decades, largely through man-induced interference. In many cases road building can be indicated as responsible for impaired stream quality, particularly where road constructions are adjacent to stream systems and where sediments and debris are dumped directly into stream courses. 20/ One research team has

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18/ Casebeer, R. L. Monitoring the 1964 Spruce Budworm Aerial Spray Project. U.S. F.S., Jackson, Wyoming, December, 1965, pp. 6-11; Corley, B. R., Bjornn, T. C., and Webb, W. E., The Effects of a DDT Spray Application Program on the Aquatic Organisms in Hughes Creek, Idaho - 1963 - 1964, Prepared by Idaho Fish and Game Department in Cooperation with U.S.F.S., Region 4, 1965; and Toko, H. V., Insecticide Tested on Forest Land to Kill Spruce Budworm, Lewiston Tribune, Lewiston, June 26, 1969.

19/ Statement by Stuart Murrell, Idaho State Fish and Game, Moscow, Idaho, December 3, 1969.

20/ Chapman, D. W., Physical and Biological Effects of Forest Practices Upon Stream Ecology, Idaho Cooperative Fishery Unit, University of Idaho, Moscow, Idaho, (mimeo), n.d. p. 1

estimated that under natural conditions a minimum of 25 years is needed to stabilize road surfaces in order to: (1) reduce sediment production to a point where it will not be detrimental to the stream; and (2) permit the stream to clear itself of sedimentation materials and return to a stable condition. 21/

Extra-heavy sediment loads in streams are detrimental to fish populations. According to Platts 22/the reduction in anadromous runs is caused mainly by: (1) a reduction in adequate resting spaces for migrating fish; (2) the covering of spawning grounds by sediment; and (3) large reductions of food production and limited rearing areas.

The South Fork Salmon River is the outstanding example illustrating the degraded quality of a major tributary stream habitat in the Batholith. Field inspections demonstrated that the habitat was in good condition prior to 1952 but fish populations, both resident and anadromous, have declined markedly in recent years. 23/ One authority commented that approximately 90% of the spawning beds on the South Fork Salmon River have been destroyed. 24/ Table II-2 shows the reduction of annual salmon redd counts in the South Fork of the Salmon River. A similar experience has occurred in the Clearwater River in the northern area of the Batholith. 25/

Forest fires can also result in abnormal contributions of sediments of streams networks. A case in point is the Poverty Flats Burn area of the South Fork Salmon River. In Poverty Flats a man-caused forest fire burned approximately 850 acres near the South Fork in 1960. During the following two years the burned over area was salvage-logged, then contour-trenched and seeded in an attempt to regenerate a grass and ponderosa pine cover. Subsequently, an intense storm in December, 1964 caused massive slumpage, surface erosion and added an estimated 45,000 cubic yards of sediment to the river channel. (Fig. II-9) Krassel Hole, a natural pool in the South Fork Salmon River a few miles downstream from the Poverty Flats burn, was inundated with sediment deposition. (Figures II-10 to II-12). Extensive dredging of Krassel Hole was accomplished in 1966 in order to restore the natural pool, however, sediments again filled the pool in 1967.

21/ Arnold and Lundeen, op. cit., p. 118

22/ Platts, William, Aquatic Habitat Survey of the South Fork Salmon River, Idaho, with Evaluation of Sediment Accruement, Movements, and Damage, U.S.F.S., Payette-Boise National Forests, March, 1968, p. 1.

23/ Ibid., p. 1

24/ Statement by D. W. Chapman, Professor of Forestry, Leader, Idaho Cooperative Fishery Unit, University of Idaho, Moscow, Idaho, January 5, 1970.

25/ Statement by Stuart Murrell, Idaho State Fish and Game, Moscow, Idaho, December 1, 1969.

TABLE II-2

Annual Salmon Redd Counts, South Fork of Salmon River and Total Idaho Count

Year	South Fork Salmon River	Total Idaho
1954		6,242
1955	2,746	9,394
1956	2,067	8,608
1957	2,756	13,689
1958	1,218	6,805
1959	1,305	5,818
1960	2,306	9,825
1961	1,058	9,670
1962	1,589	8,641
1963	1,057	7,256
1964	1,124	7,157
1965	656	3,738
1966	980	7,038
1967	902	---
Total	19,764	103,881
Average	1,520	7,991
High	2,756	13,689
Low	656	3,738

Platts, William S., South Fork Salmon River, Idaho Aquatic Habitat Survey with Evaluation of Sediment Accurement, Movement, and Damage, U. S. Department of Agriculture Forest Service, March, 1968, p. 67.

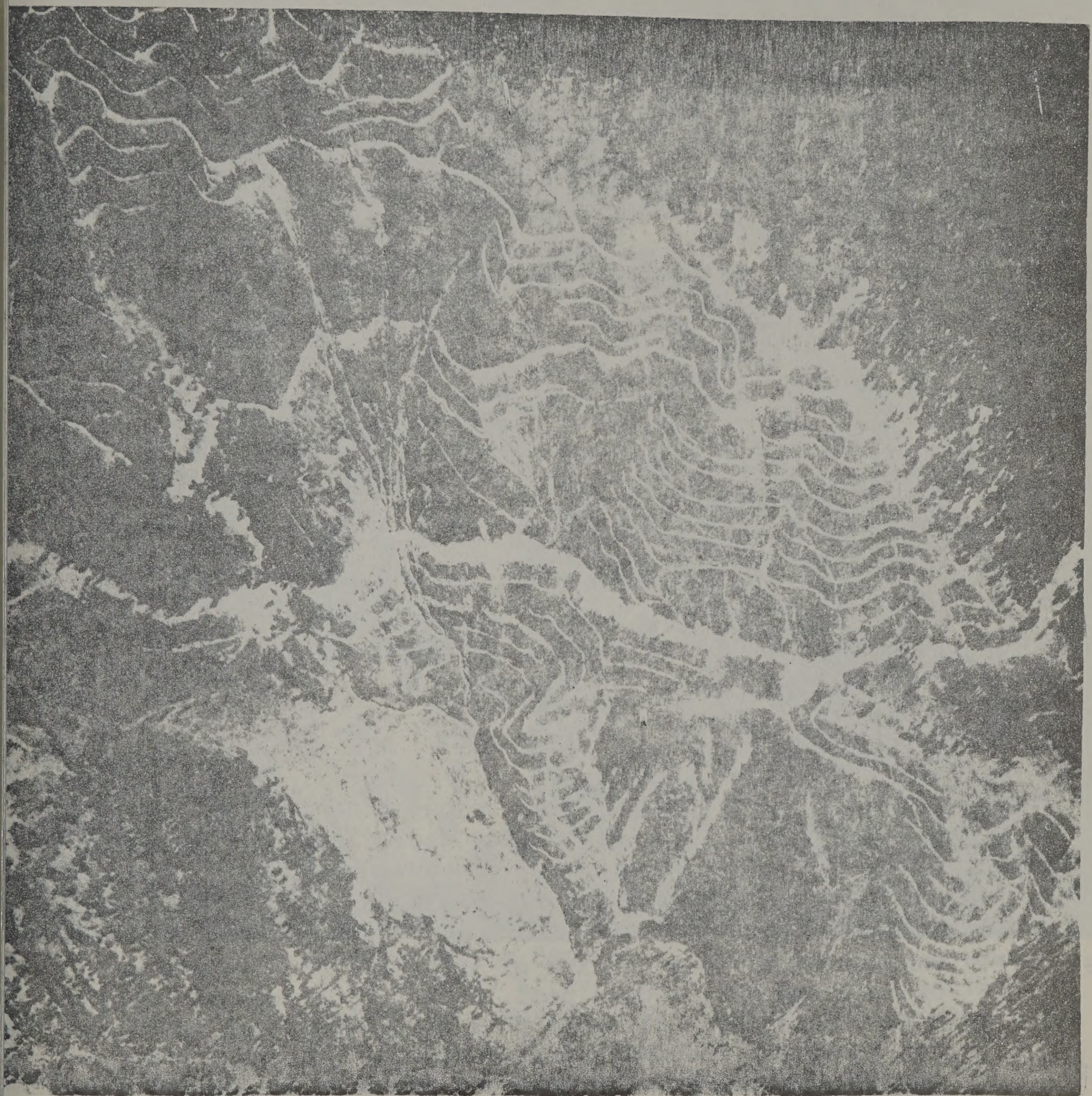

Fig. II-8. POVERTY BURN. Burned by a forest fire in 1961, this area was later salvage logged and contour trenched. During the January, 1965 storm, numerous large slides occurred, contributing an estimated 45,000 cubic yards of sediment to the South Fork Channel. (Courtesy of U.S. Forest Service, Region 4)

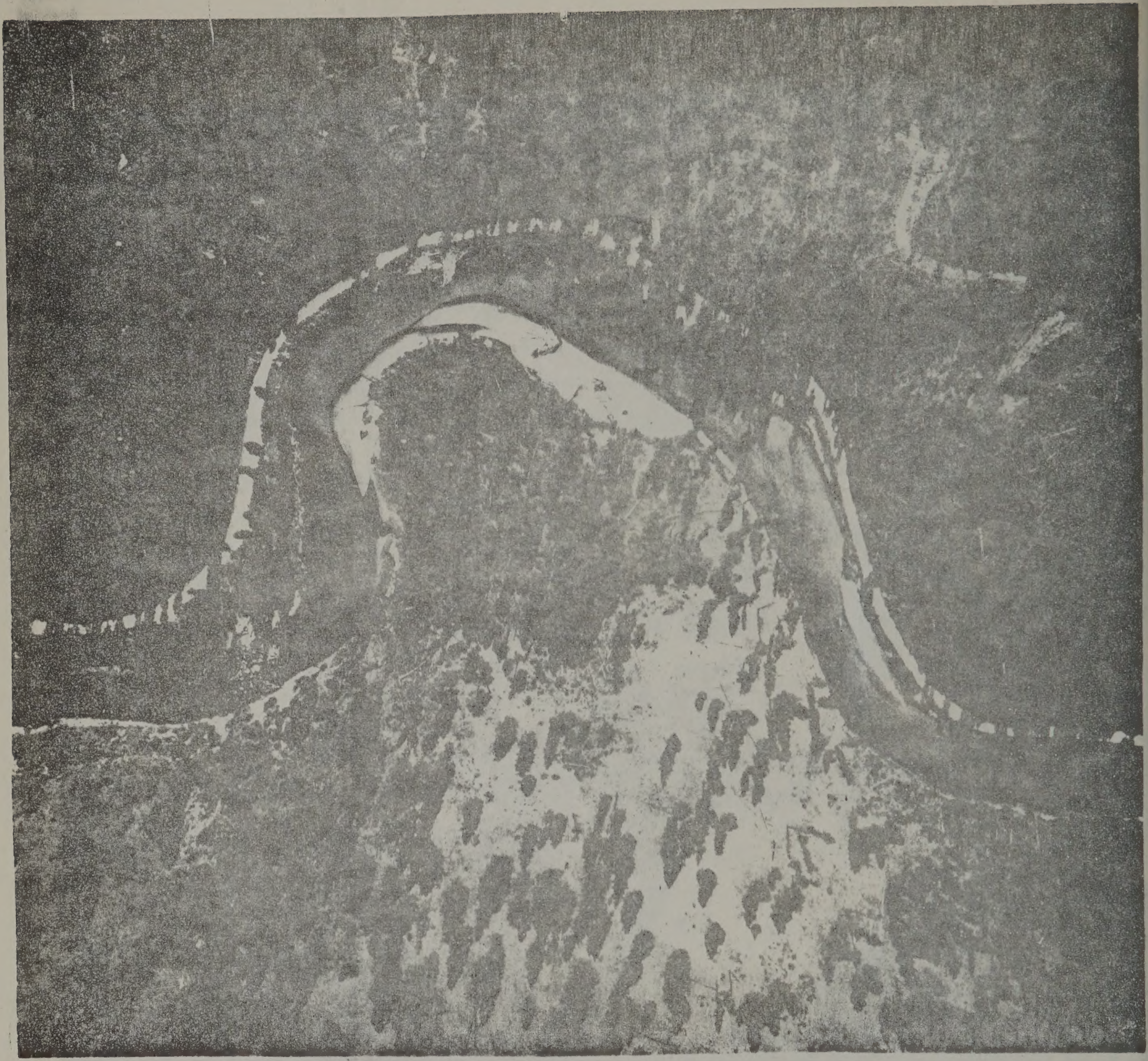

Fig. II-9. KRASSEL HOLE. This portion of the South Fork Salmon main channel was once a deep pool. Recent high sediment production completely filled the pool with deposition material, including the channel upstream from it. The pool was cleaned of 16,000 cubic yards of sediment in 1966. Following the high spring flows in 1967 the dredged portion of the channel completely refilled with sediment materials. (Courtesy of U.S. Forest Service, Region 4)

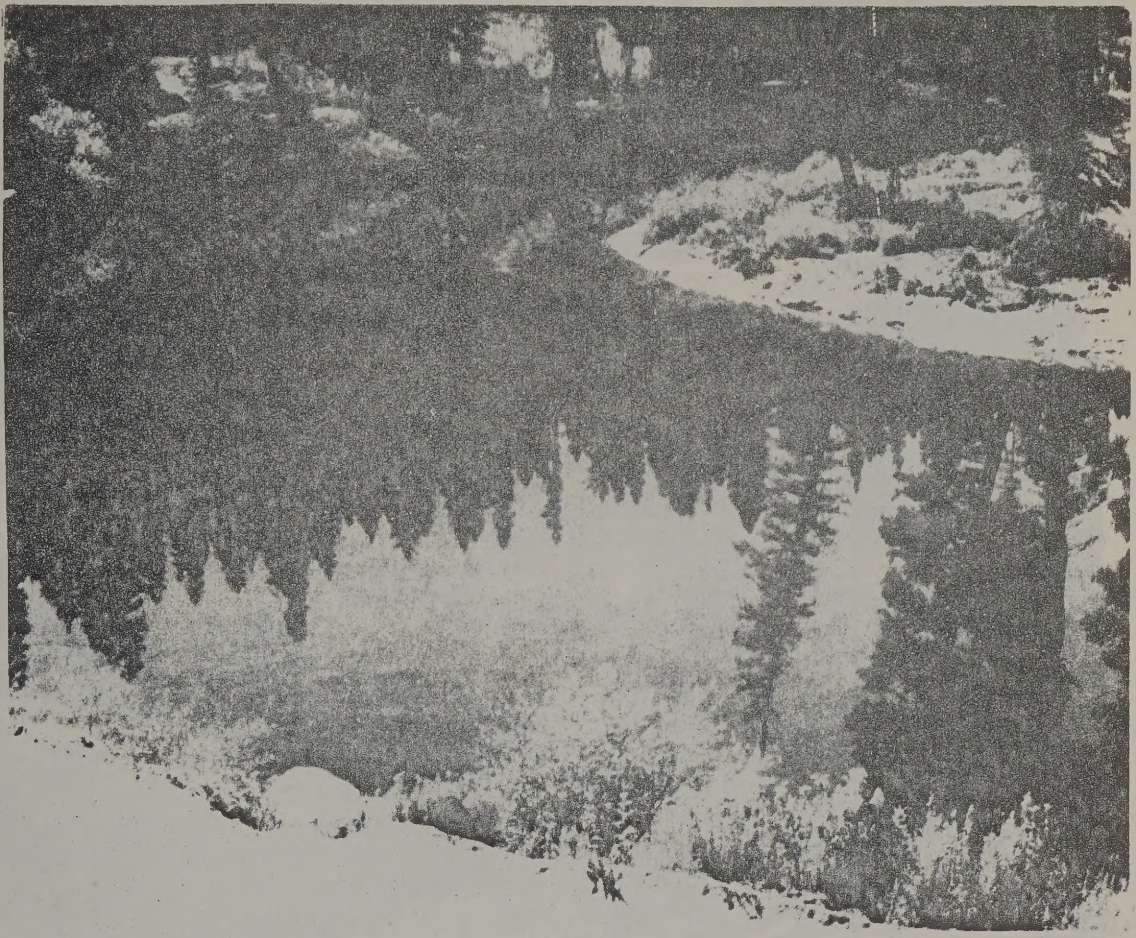

Fig. II-10. KRASSEL HOLE. Approximately 1,500 feet of the South Fork Salmon River channel at this point was cleaned by removing the sediment deposits with a dragline. Sixteen thousand cubic yards of material were removed from this section of the channel in September, 1966. This photo was taken shortly after completion of the dredging operation. (Courtesy U.S. Forest Service, Region 4)

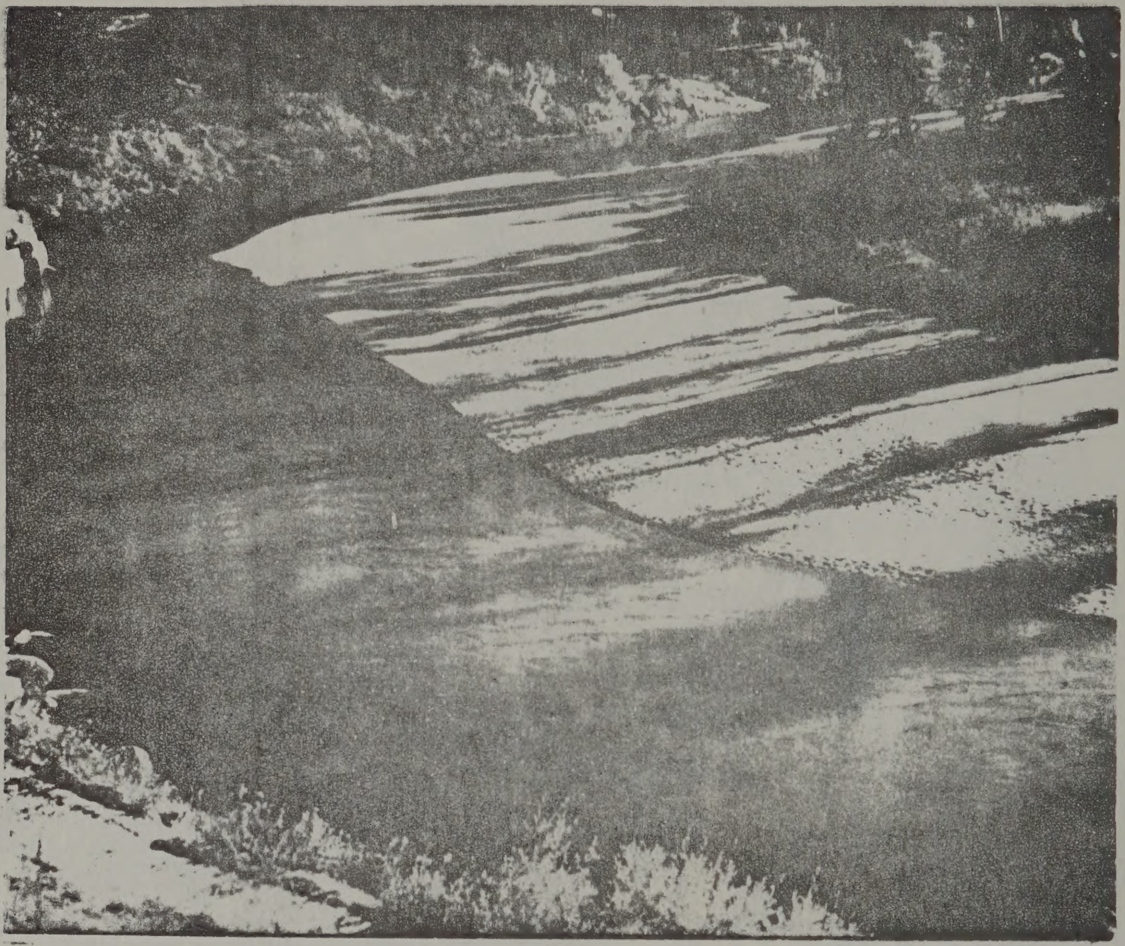

Fig. II-11. KRASSEL HOLE. The spring runoff in 1967 refilled the Krassel Hole with nearly the same volume of sediment materials (16,000 cubic yards) which had been removed. (Courtesy of U.S. Forest Service, Region 4)

If natural streams and healthy aquatic habitats are to remain throughout the Batholith, those land uses and practices that create excessive sedimentation must be controlled or eliminated. Although it is possible to improve impaired stream courses through dredging or to increase fish populations by artificially establishing spawning beds, the cost of these methods is high in money and manpower. A management program of preventive measures should be preferred to mitigative measures. The Forest Service, for example, must avoid the habit of consulting specialists (fisheries biologists, soil scientists, and hydrologists) "after-the-fact," when only mitigative measures are applicable. 26/

CHAPTER III

PROBLEM ORIGINS

The environmental problems in the Batholith reflect far more than just impact factors; their origins are based on past and present management practices. This section explores and analyzes those practices in terms of controversial management concepts.

Legacies

An important aspect affecting the present day management in the Batholith is the legacy of unrestrained and destructive land use practices inherited by both the Forest Service and the Bureau of Land Management. Initial settlement of the Batholith lands was concomitant with mining, lumbering and grazing activities before the turn of the twentieth century. Early logging practices generally had little impact, but the tradition of unrestrained timber exploitation and the advent of more modern, heavy, mechanized equipment have brought about many of the logging and road building problems faced today. In the southern portion of the Batholith where important grazing resources exist, livestock raising evolved as a primary activity and, again, involved uncontrolled land use. Intense competition for grazing lands led ultimately to land uses exceeding sustained yield capacities and to a serious deterioration of soils and the range resource. The tradition of access for users and the establishment of laws, regulations and policies that have favored exploitation has permitted the continuation of numerous land use abuses.

Failure to Recognize Problems

For years the Forest Service failed to recognize the special needs and uniqueness of the Batholith. Agency administrative focus was on the "custodial phase" of management with only incidental concern for watersheds and recreation and virtually no consideration for esthetics. There has been a tendency on the part of the Forest Service to employ management practices that were developed elsewhere and not necessarily applicable

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26/ Chapman, op. cit., p. 6; and Arnold and Lundeen, op. cit., p. 42.

to the Batholith. Because of the combination of vulnerable soils, high degree of slope and the occurance of high intensity storms, road construction should have been limited to a minimum such as those utilized in skyline and high-lead logging techniques developed in Washington and Oregon. 27/ In reviewing numerous recent research efforts, it seems that most studies have emphasized the definition of problems but neglected to identify measures to resolve them. Land managers, for example, need to know more about grazing use impacts and grazing potentials on the granitics. 28/

Probably responsible for most management oversights is the lack of basic information and data. Without the needed data, interpretive and management decisions tend to be arbitrary or based on assumptions later proved invalid or erroneous. Forest Service officials in Region 4 now realize that the use of salvage-logging and contour-trenching with seeding for regenerative purposes in high intensity storm areas is impractical as illustrated by the Poverty Flats Burn project.

Decision-making and multiple use planning require procedures and guidelines that must be developed in order to interpret and integrate regional themes for the individual District unit. The Magruder Corridor issue might not have come about if proper information and procedural analyses had been employed.

Inadequate Staffing

Management under the multiple use concept as defined by Public Law 86-517 (June 12, 1960), has meant new obligations and heavier responsibilities for the Forest Service. Another facet in the origin of the problem is in the limited size, training and use of the professional staff. The technical staff is too small and has had insufficient support to conduct the necessary surveys prior to the development of a comprehensive management plan to conform with the requirements of the Sustained Yield and Multiple Use Act of 1960. Administrative personnel were also slow to readjust to some of the new concepts and few were trained to consider environmental impact. Because of budget limitations, interagency differences in priorities and outlook, and existing completion schedule dates, some programs were implemented before the necessary studies were completed. When crises developed in a portion of the region, staff time would be pre-empted to the detriment of evolving a multiple use management plan. Recommended changes or suspension of practices resulting from internal and external research staffs were slow to be implemented and in some cases were implemented with reluctance.

Special legislation has pre-empted portions of the area for designation as Wilderness or Wild or Scenic rivers. (Figures III-1 and III-2). In attempting to translate these diverse pieces of legislation into land management programs, numerous difficulties were encountered, including

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27/ Confidential source III-1

28/ Coons, op. cit., p. 7.

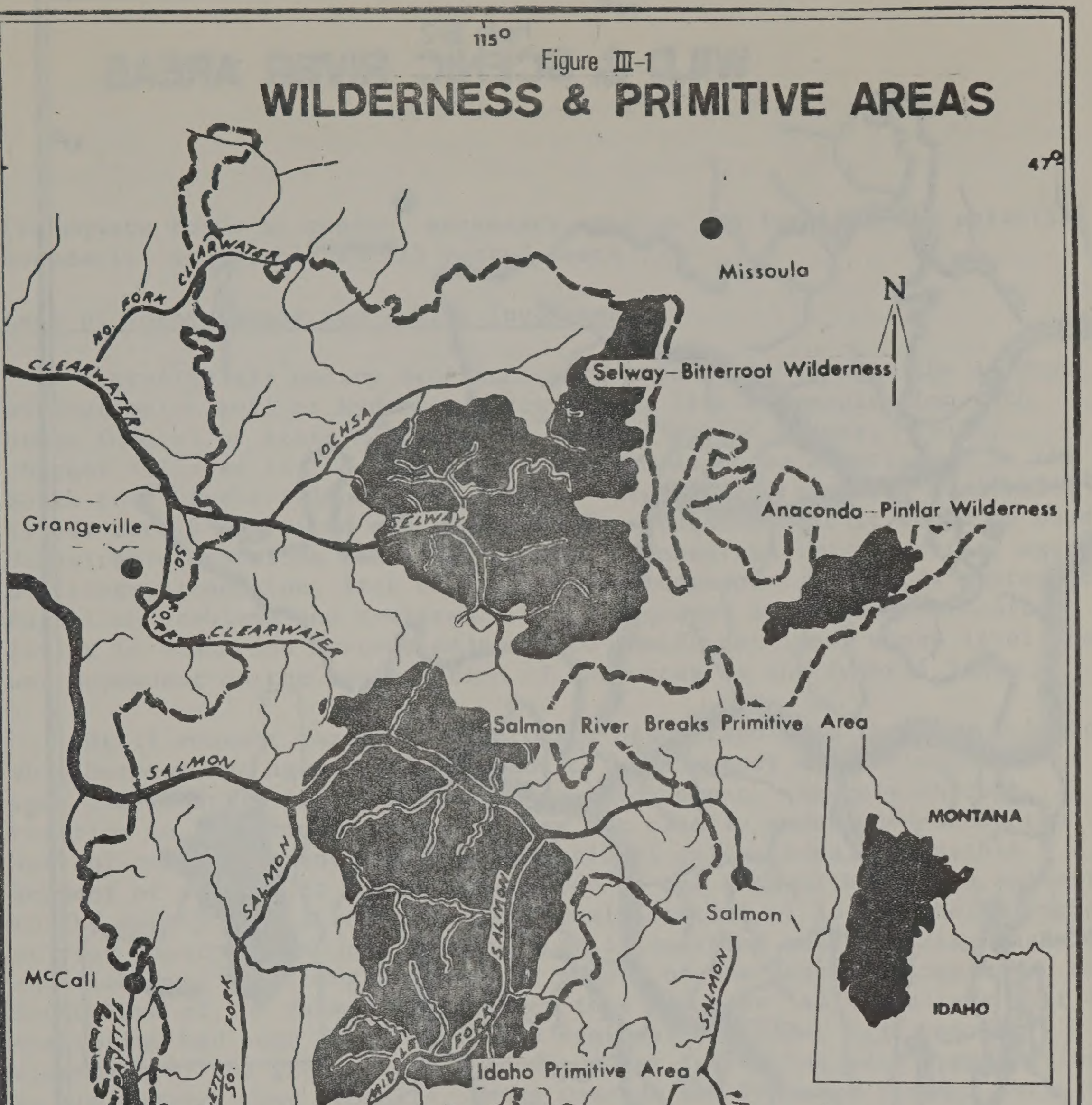

Fig. III-1. Map of the wilderness and primitive areas of the IDAHO BATHOLITH.

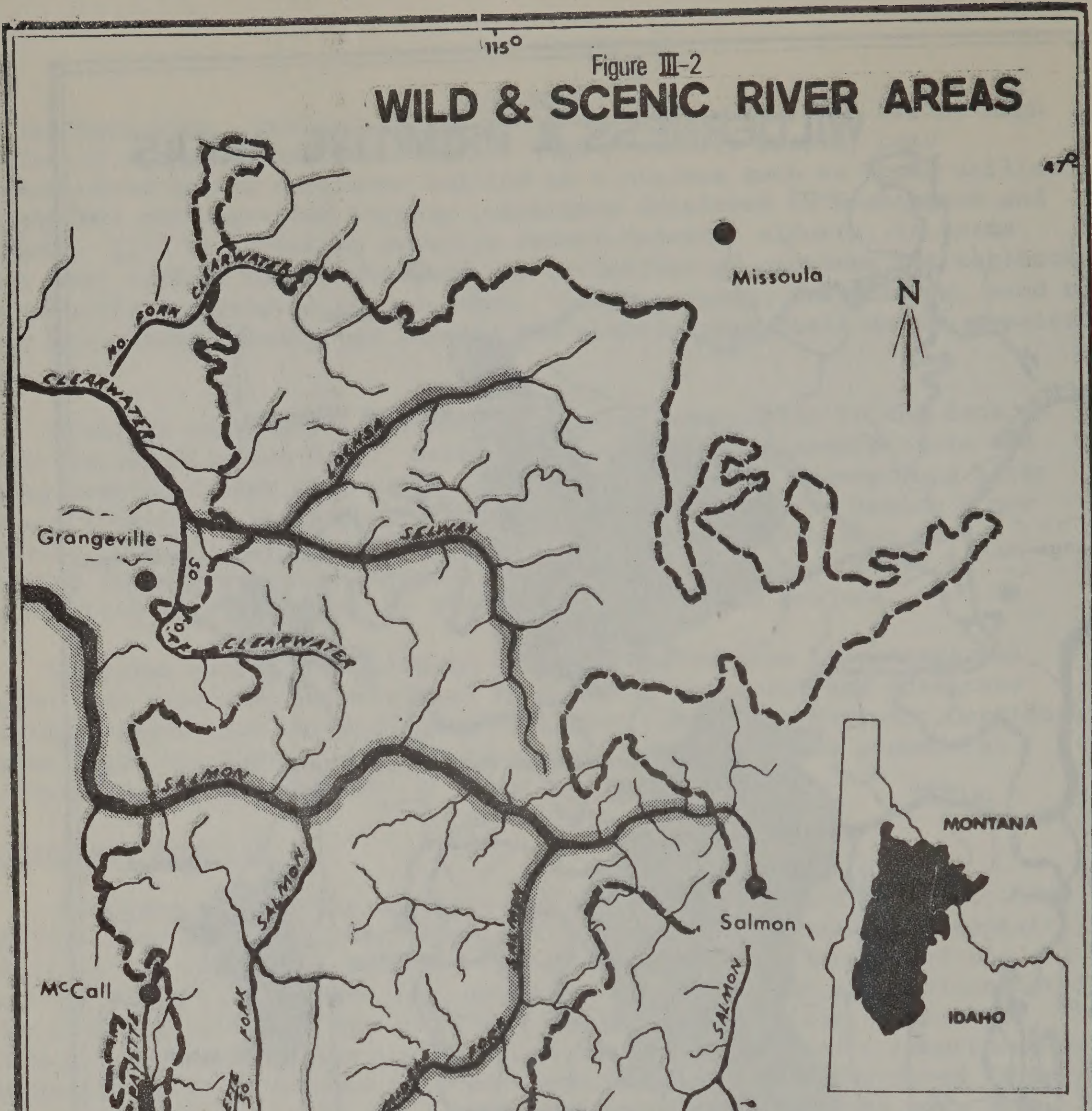

Fig. III-2. Map of the wild and scenic river areas of the IDAHO BATHOLITH.

inadequate funds to conduct necessary studies and inability to establish boundaries acceptable to all vested users.

Lack of Inter-agency and Public Involvement

Virtually all policy decisions were made wholly within the agency without prior soil or hydrologic studies or little consultation with other federal or state agencies, or general public groups. Policy changes followed in the wake of crises such as those experienced in the South Fork of the Salmon River. Where outside expertise was available, it was rarely solicited and then with no assurance that it would be used. Undesirable practices continued because of obsolete laws, codified agency practices, tradition, lack of adequate environmental standards geared to Batholith problems and resistance by user groups and those residents living in Idaho and Montana adjacent to the forest lands whose livelihood was dependent on the exploitation of resources on the federal lands.

Still another facet of the problem has arisen from the poor relationship between the agency and the public. The agency was reticent and to some extent still is to obtain public involvement. Largely through reaction to a particular local policy not clearly understood or by the lack of public awareness of the operational guide lines, a sizeable segment of the public residing adjacent to the Batholith harbors animosity to the agency. This includes individuals fearful of losing their logging or road construction jobs, ranchers still smarting under grazing restrictions and fishermen or biologists wary of rumors of new proposed logging on the South Fork of the Salmon River after they had been led to believe that a moratorium had been declared by the Regional Forester. 29/ Another dimension of the problem comes from popular fears that such organizations as the Western Wood Products, Boise Cascade and Potlatch Forest, Inc., have undue influence on the decision-making process in the agency.

Associated Problems

Some of the management problems in the Batholith relate to past Congressional action.

Mining law appears to be both complex and archaic. Environmental damaging by mining, though small in area in terms of acreage or square miles within the Batholith, can precipitate serious problems. Once a mining claim has been filed on public land, the Forest Service has no jurisdiction over that area. Prospectors may virtually destroy the environment by bulldozing, blasting and clearing and in so doing scar the landscape, destroy grazing, and pollute streams, without any assurance that minerals are even present in exploitable quantities.

The Taylor Grazing Act of 1934 prescribes BLM Advisory Boards at the District and State levels. At the District level the board frequently

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29/ Confidential Source, III-1

consists of five to twelve elected stockmen plus a wildlife representative appointed by the State Director. The District Board constitutes a de facto group which prevents an environmental quality orientation in BLM land management. On the state level the Advisory Board has a broader base.

The Wilderness Act of 1964 (Public Law 88-577) has created some confusion regarding the installation of scientific data-collecting instruments in Wilderness areas. Although the law does not prevent the gathering of information within Wilderness areas, it prohibits the erection of structures and installations. Wilderness areas in the Batholith are the source areas for many of the stream systems and the Forest Service feels headwater analysis is essential for proper management and water forecasting in downstream areas. The Forest Service would like to erect permanent instrumentation units, a plan they feel does not violate the spirit of the Act. 30/

CHAPTER IV

ENVIRONMENTAL CONSIDERATIONS

There is almost no evidence that there existed a widespread practice of taking environmental or ecological factors into consideration until the mid-1960's; furthermore, there is little reference to public hearings or use of external expertise or contract research in any of the special problem areas. One exception was an early project 31/ geared to measure ecological impact which dealt with DDT spraying on the northwest edge of the Batholith in 1949 when a number of agencies and groups collaborated to monitor the experiment. In most instances studies and surveys followed significant damage or crises.

In the classic Zena Creek areas 32/, logging started on the river terraces about 1946 and then proceeded upslope with a network of contour roads that achieved a density of seven roads per slope. Subsequent slumping and erosion produced a regional ruling by 1950 that classified Batholith slopes over 50% as unloggable. The next step was to design or use equipment capable of logging with fewer roads but it was not until 1958 that the Zena Creek Logging Study was initiated. It was directed by an eleven-man committee consisting of research and administrative personnel meeting semi-annually as the Zena Creek Committee. From their findings new criteria for management have been evolving and providing guidelines for use in the development of the Batholith multiple use plans. Emphasis was on soil, hydrologic, geomorphic, and climatological factors. Subsequent findings transmitted to other land managers focused on land unit classifications and the development of new guidelines on road location, construction

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30/ Region 1, U. S. Forest Service, Missoula, Montana, December 15-16, 1969.

31/ Adams, Lowell and others, "The Effects on Fish, Birds, and Mammals of DDT Used in the Control of Forest Insects in Idaho and Wyoming." Journal of Wildlife Management, Vol. 13, 1949.

32/ Hydrologic Analysis Report of the Zena Creek Logging Study Area, 1966.

and rehabilitation. Special in-service committees established in other critical areas were the Silver Creek and South Fork Salmon Committees. The development of a crisis in the South Fork of the Salmon River did generate collaboration with other agencies but still no public hearings were held to ascertain policy change considerations.

The Sustained Yield and Multiple Use Act of 1960 and a series of storms in 1964 and 1965 generated policy changes as the public became aware of the damage that resulted from previous land management practices. Changes also reflected pressures from within the agency in the views of technical personnel. Although many view the Act with suspicion, officials within the Forest Service and such outside groups as the BLM and the State Fish and Game Department, give wholehearted endorsement of the Sustained Yield and Multiple Use Act and efforts to implement it. Some confusion still exists for those who think that multiple uses are mandatory through the area. A single dominant use for certain areas of the Batholith is permissable and consistent with the Act.

A significant Forest Service innovation 33/ was the creation of the Batholith Steering Committee in 1968 composed of several soil and water management administrators, one research director and a soils and geology oriented liaison officer stated in Boise. This group generates data collection 34/, encourages research and disseminates the results to ensure that the unique soil and hydrologic characteristics will be recognized in the development of multiple use management units for each of the affected areas. 35/ There is still limited contact with other agencies, private groups and the general public.

During the past four to eight years there has been a widening of the background training base of professional personnel in the research and regional offices to include more soil scientists, engineers, landscape architects, hydrologists and geologists - to ensure consideration of special environmental and aesthetic needs. Visible clear-cut logging scars may generate more emotional local reactions than road construction. The Forest Service, aware of this public bias, is attempting to reduce scar visibility 36/ and its landscape architects advise in clear-cutting design.

Though environmental impact planning is still incidental, the Regional Forester in 1968 stopped road building and logging along the South Fork of

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33/ Coons, op. cit.

34/ Arnold, op. cit.

35/ Soil Hydrologic Reconnaissance, Cascade Ranger District, Boise National Forest, U. S. Forest Service, July, 1969.

36/ Oral Communication, U. S. Forest Service, Region 1 and 4 personnel, Boise and Missoula.

the Salmon River until techniques could be devised to permit satisfactory road building or roadless logging. The Forest Service has also been steadily curtailing grazing and in some instances completely discontinued the issuance of grazing allotment permits because of damage from overgrazing.

At the same time, BLM has generally been less effective in its attempts to curtail grazing because of user oriented laws, regulations, and procedures. BLM did impose strict grazing cutbacks in the Jerusalem Area in the western fringe of the Batholith. In some units of this area 70% of the grazing privileges were denied to cattlemen. 37/ Both agencies have encouraged grazing livestock to move from the steep slopes to the more stable valley bottoms.

External user groups with a long record of policy impact appear to be the Boise Cascade Corporation for the southwestern portion of the Batholith, the Potlatch Forests, Inc., in the northern section and the Western Woods Products Association throughout. Other lobby groups representing cattle, sheep and mining interests have been active. Wildlife and perservationist groups which often include urban, academic and professional individuals, have become increasingly vocal in their attempts to express an environmental-ecologic view as exemplified by their involvement in the Magruder Corridor and the White Clouds issues.

Significant procedural changes followed in the wake of the Magruder Corridor incident when the Secretary of Agriculture appointed an external study group, the multi-background, respected "Selke Committee." 38/ The use of such outside groups insures a healthy external appraisal and evaluation of agency management practices and also helps restore public confidence in the agency and the decision-making process.

A major innovation in policy decision-making 39/is underway in Missoula, Montana, where there is a plan under development to ensure adequate prior studies, inter-agency planning, and regional public involvement with field trips, reviews and hearings. Hopefully, such a procedure will become standard at all planning and decision-making levels. This will ensure an opportunity for all interested groups to participate and guarantee consideration of environmental factors.

ALTERNATIVES

Historically, the Forest Service's supervision of the Batholith has reflected first a period of custodial care followed by a period of

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37/ William Meiners, BLM, Boise.

38/ Selke, *op. cit.*

39/ Coil, James, et. al., Critical Path - Salmon River Breaks Reclassification Study, U. S. Forest Service, Missoula, Montana, July 18, 1969; Revised August 13, 1969.

management for production. Most recently and prodded by internal as well as external forces, there has been a slight change toward management of the land rather than of its individual resources within a framework of its social needs, and environmental responsibilities.

This agency, like others involved with land management, changes slowly and the hierarchy in decision-making tends to ensure that individuals most resistant to change are in positions most capable of implementing change. Certainly, elements of this are inevitable based on seniority and the promotion of individuals whose outlook, values and training parallel those in power. Outside this agency important considerations should include a reduction of proportional influence by user groups and an increase in influence by the academic community and the lay public, in addition to the present influence of hunters, fishermen, and preservationists.

Guiding Philosophy

The guiding pholosophy should be that exploitation of resources of the Batholith should be permitted only when it can be shown that the stability of the terrain and the quality of the water and watershed can be maintained within reasonable limits.

First priority should be the creation of a working decision-making group involving representatives of state and federal agencies, user groups, ecologic groups and the academic community to establish maximum allowable limits of deterioration for the land and water resources. Common standards, measurement techniques and monitoring systems must be developed. A comparable group should work toward the rehabilitation of existing problems in the Batholith.

All laws, procedures, practices and regulations currently implemented in the Batholith should be re-examined to insure compliance with the limits of deterioration set by the group. This is particularly important when applied to questions of water quality and the enforcement of water quality standards.

Specific Alternatives

1. Within the Forest Service, the entire decision-making process should be redesigned into a new framework to ensure that environmental impact factors be considered prior to making a decision. This may well require

   (a) changing present budgeting and funding to ensure that total land management be regarded as an interrelated decision rather than as separate items with individual allocation of funds for line items as timber management, soils, range, etc.

   (b) providing more latitude in the transfer of line item funds.

    (c) re-examining present district level budgeting in order to de-emphasize the production-oriented project budget at the same time increasing the relative importance of the base budget.

    (d) separating some of the technical support from project budgets to reduce possible budget pressure on them.

2. To achieve Alternative 1, it will be necessary to identify the knowledge gaps and devise means of acquiring the necessary information with adequate funding.

3. The range of skills and knowledge of the technical, research and administrative staffs should be widened to ensure greater insight and breadth and might include regional planning, transportation, ecology, geography, psychology, and sociology.

4. Re-evaluate the entire education and information framework of the agency to ensure that

    (a) all internal parts of the agency become fully cognizant of shifts in emphasis and priorities and that everyone has an understanding of the logic and rationale for the same.

    (b) individuals residing in areas adjacent to national forests come to believe and trust that the forests are being managed as a public trust.

    (c) liaison be established with the general public through the academic and lay community.

5. The question of National Forest advisory committees, their role, appointment and composition should be re-examined. Funds should be provided for travel to periodic meetings and a small token honorarium considered to ensure a greater commitment by individuals to the advisory function.

6. (a) The Batholith Steering Committee or other similar group should periodically initiate regional conferences for road builders, loggers, recreationists, and lay individuals to help disseminate research findings and to analyze their significance in operational practices and environmental quality.

    (b) The Steering Committee might well initiate conferences for interested groups to analyze the implications of the present laws on customary Batholith land uses. From these conferences evolve recommended changes in laws such as one that would permit the installation of fixed instrumentation in Wilderness and Primitive lands in order to gather scientific data for management without violating the spirit of the Act.

7. BLM operations indicate the need of alternatives to the present selection and role of Advisory Boards to insure representation by other agencies, professionals and the general public and a de-emphasis on users. This agency would benefit from continuation of the Multiple Use Act of 1964.

8. It is apparent from the Forest Service point of view that more control is needed in regulating mineral exploration, tailings removal, and surface restoration. The Multiple Use and Management Guide [40]/states that "present controls are still inadequate" in this regard. The Forest Service point of view seems to be justified after reviewing the events in the study area. Other mining alternatives worthy of consideration are the termination of the patented claim concept, assignment of jurisdiction to the agency managing the surface area, leasing of mineral rights, the establishment of performance standards on all effluent and required landscaping.

9. Roads should be required to follow the natural terrain, avoiding cut and fill operations. The routing should be geared primarily to rock materials rather than distance factors. The regulation and policing of road construction and road location must be improved and, whenever possible, road mileages be restricted to absolute minimums. The visibility of the road in areas of outstanding scenic beauty should be reduced to minimize aesthetic conflicts. Fill areas should be treated or seeded to reduce erosion and ground cover re-established to make the road as inconspicuous as possible. As logging roads constitute the main problem it would appear that another alternative would be the development of roadless logging techniques. One experimental balloon logging project is contemplated in conjunction with the Boise Cascade Company. Other alternatives involve the immediate shifting to skyline and high-lead techniques throughout the Batholith.

10. All standards should be reviewed at designated intervals of five to ten years to insure continued evaluation of existing practices and the development of improved regulation and procedures.

Postcript

By necessity this report focused on problems and issues concerning multiple use practices. The intent has not been to chastise federal agencies, especially the Forest Service in their management role. In retrospect this agency should be commended for its management innovations and its research initiative to identify and help solve Batholith problems.

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The research team publically acknowledges the superb cooperation at all levels of the U. S. Forest Service personnel from Regions 1 and 4 in providing it with candid informative answers and access to numerous in-service reports.

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CASE STUDY NO. II

LAKE TAHOE,
CALIFORNIA AND NEVADA

by

SAM BAMBERG

Prepared Under a Contract With The
Rocky Mountain Center on Environment
Denver, Colorado

I. RECITATION OF FACTS AND NATURE OF PROBLEM

Lake Tahoe is unique in its beauty and clarity. This blue lake amid forested green mountains appeals to our emotional sense of pleasure and exalts the spirit. The effort to preserve the beauty and integrity of Lake Tahoe has focused the attention of a nation that realizes its vanishing natural resources. The qualities of Lake Tahoe that attract people to its shores are being threatened by the same people who come to enjoy these qualities. This case study attempts to determine the problems facing the agencies responsible for the Lake Tahoe Basin and how these problems can be alleviated.

a. Physical Description

Lake Tahoe and its associated basin cover 506 square miles, 314 square miles of land and 192 square miles of lake surface. (Fig. 1) Altitudes vary from 6,225 feet at the Lake surface to above 10,000 feet on the west side and south rim. An outstanding feature of the Lake is its great depth, 1,640 feet, and a large volume of 122 million acre feet.

Associated with this large volume of water is a slow rate of recharge; 600 to 700 years are required to fill the lake from the relatively small surrounding catchment basin. Drainage from the Lake, through the Truckee River, is northeast into Pyramid Lake.

b. Vegetation

Forests of pine and fir clothe most of the Tahoe Basin slopes, these intermix with Great Basin shrub on drier or steeper areas, and meadows on leveler, deeper soils. The topography is steep with only 36 percent of the Basin land areas below a 25 percent grade. Soils are of granitic or volcanic origin and very susceptible to erosion and slides.

c. Climate 1/

The Lake Tahoe Basin is characterized by a low mean annual temperature (42.2^{o}F), short growing season (about 70 days) and moderate to heavy precipitation, chiefly winter snow. There is great variability in the climate in types and amount of precipitation and range of temperatures. Heavy winter snows and summer droughts or thunderstorms are common. Temperature inversions, in which cool air overlain by warmer air collects in the basin, occur frequently in calm weather.

d. Basin Ecosystem and Associated Habitats

The natural ecosystems in the basin landscape present a mosaic of particular vegetation, soils and animals developed in relation to topography

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1/ Dr. J. E. Chruch's original snow survey work around Mt. Rose in the northeast part of the Basin, is worth particular note.

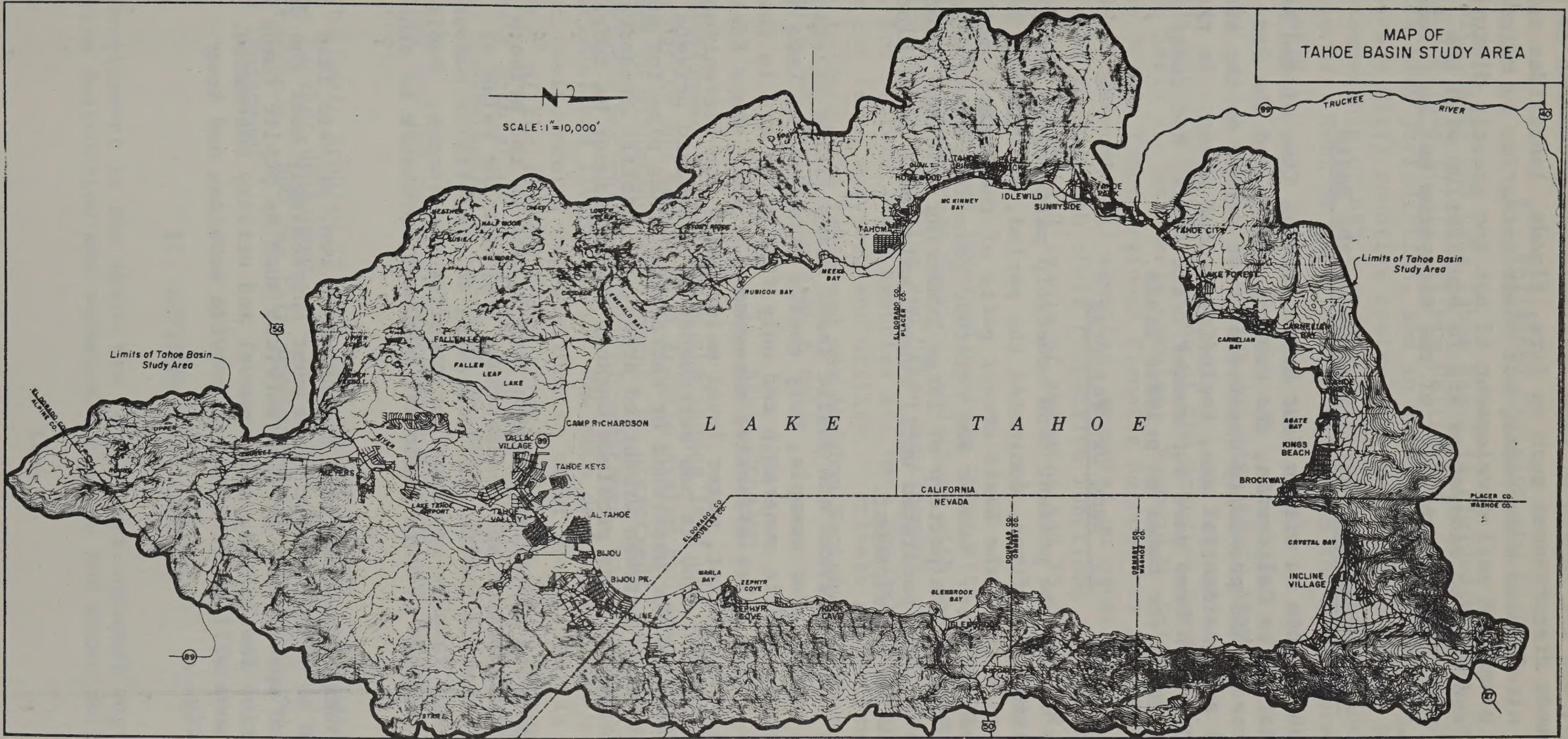

Fig. 1. Map of Tahoe Basin Study Area.

climate, geology, and the length of time available for processes to work. Natural and manmade disturbances such as fire, floods, landslides and snow avalanches alter these ecosystems, but their integrity is maintained by processes of plant and soil development if not too greatly disturbed. Both terrestial and aquatic ecosystems are in equilibrium with the environment and any change in one part of the ecosystem has an effect on all other parts.

e. Increasing Public Demands on the Basin

The Lake Tahoe Basin is within four hours driving time of two major centers of population in California, the Central Valley and the San Francisco Bay area. This proximity creates a great demand on the area for recreational and residential use, including second homes. In the past, public lands have been used for summer tract homes, but today the demands are increasing for homes on private lands.

f. Land Use Patterns

History has shaped the present land ownership patterns in the Basin. Lumbering with associated fires, dominated the period, and grazing between 1860 and 1890 when most of the Basin except parts of the rugged southwestern slopes was denuded. Lumber and railroad companies owned major portions of the basin. The pattern of large lumbering holdings interspersed with public land persisted until recent sales made large blocks of land available for development.

The present mix of private and public lands bears little relationship to existing needs. For example, only twelve miles of the Lake's 70 mile shoreline are in public ownership and only five miles are in the National Forests. This makes effective management of Lake shore features for wildlife and fish habitat, water level maintenance, or recreation impossible. Some public land is now surrounded by urbanized private land which cannot be managed for watershed or recreation. Any plan for buffer zones or for open space between urbanized areas, for habitat preservation and watershed management, has problems because zoning cannot be correlated with use.

There is a growing disparity between land values in the private and public sectors. Development and reassessment increase the value of private lands adjacent to public land providing an exploitable resource for developers and a taxable resource for counties and states. Public lands and underdeveloped private lands are put under pressure as other land values rise.

Taxes and assessments make land expensive to own; private land must be developed or lost. Public lands must increasingly bear the demand for recreation and open space, and for services such as public roads and other transportation facilities, snow removal and utility easements. Public agencies soon will be strained to provide services and keep development orderly.

g. Political Division and History

Politically the Lake Tahoe Basin is divided between California (73%) and Nevada (27%). Within California, El Dorado and Placer counties have jurisdiction, and in Nevada, Douglas, Washoe and Ormsby (now Carson City) counties control the east and northeast portions. Public ownership of 48% represents principally national forests and state parks. Most of this land is back from the Lake shore and not developable.

h. Governing and Regulatory Agencies

The structure and function of the agencies responsible for Lake Tahoe and the Basin are extremely complex. Raymond M. Smith, Planning Consultant for the Nevada Tahoe Regional Planning Agency, has prepared a Matrix (26) of federal governmental agencies, agencies on other levels and other interested groups with their respective functions and goals (see Table 1). This matrix includes 8 levels of agencies and 75 concerned agencies or interested groups.

Federal agencies involved include those with power to regulate land use, such as the Forest Service, and those with policy setting responsibilities, such as Housing and Urban Development. Local, municipal, county, state, and bistate level agencies all have regulatory powers and there are groups for fire, service, and utility. Private groups, such as the League to Save Lake Tahoe and the Audubon Society, which represent property owners in the Basin also play a role.

i. Basic Problem

Development in the Basin challenges land use management. How can the integrity and beauty of a fragile system and environment with limited capacity to withstand development, be preserved? Can the Lake Tahoe Basin be developed for multiple uses of watershed, water resource, timber, recreational and living space? How much development can be tolerated without environmental degradation; in other words, what is the "carrying capacity" of the land in human terms? Can the Basin support a projected permanent population of 50,000 and 330,000 visitors a day in 1980 without serious consequences or reaction to such rapid growth?

What are the costs of protecting an environment and who should bear these costs?

The basic problem is that Lake Tahoe and the Lake basin are being and will be further developed as a year-round recreational resource and as a water resource. How can this development be compatible with the nature of the landscape?

II. ENVIRONMENTAL IMPACTS

Development in the basin has led to environmental degradation due to ecosystem destruction and subsequent erosion and water pollution. The disruption of drainage patterns, clearing and cutting of trees, removal of top soil and cut and fill operations for roads and subdivisions have all accelerated erosion and sedimentation. Runoff has increased, heightening the danger of floods and increasing nutrient flow to streams and lake water. The natural ecosystems are unable to absorb the impact of housing, road construction, transportation needs, water and air pollution, and resource utilization. All of the processes of land and water "aging" are speeded up: erosion of land surfaces, increased sedimentation and flooding, and eutrophication of the Lake water.

Development reduces vegetation cover; a reduction in the vegetation cover increases runoff. A canopy of trees will intercept an inch of rain and forest litter will absorb another two to three inches so that four to five inches of rain must fall before any water runs off. On bare soil or streets runoff is immediate and total.(Fig. 2) The water retaining capacity of the soil is further decreased because of greater soil freezing in early winter when warm rain on snow creates great flood hazards, according to a report on soil freezing by M. F. Taylor at the College of Agriculture, University of Nevada, Reno (30).

Development disturbs the adjusted natural land surfaces and decreases stability of slopes and soil. A study by the California Department of Conservation (5), showed that 87% of the 30,000 tons of annual sediment load of the upper Truckee River and Trout Creek watersheds south of Lake Tahoe comes from roadway and disturbed streambank erosion, with subdivision roads accounting for a major portion of this sediment.

Cutting and burning trees and brush, or cutting and filling soils releases the large amounts of nutrients stored in the plant tissue or tied up in the soil. These nutrients are washed into streams and eventually into the Lake. Not only is the nutrient cycle disrupted but the energy from the sun is no longer captured and the "engine" to run and maintain the natural ecosystem is broken down. The system cannot then repair itself and we must supply this energy at tremendous costs. Slope erosion stabilization stream and flood control, and revegetation are expensive.

Following development, plants and animals are depleted and more susceptible to disease. One example of species depletion is the disappearance of the native Lahontan Cutthroat Trout from Lake Tahoe after the introduction of exotic fish species (16, 17). Another example, documented by Peter Harlin of the Nevada State Museum (17) is the extinction of about six species of butterflies (and the endangering of several other species) because of habitat destruction in the removal of meadows, straightening of streams and decline of rare plant species on which the butterflies depend. Increasing urbanization and the widespread use of broad action insecticides also contributed to their decline. Undoubtedly, other species are disappearing due to habitat destruction, but the lack of studies prevents adequate documentation.

The esthetic value of this mountain landscape depends on the diversity and abundance of native plants and animals in their natural setting.

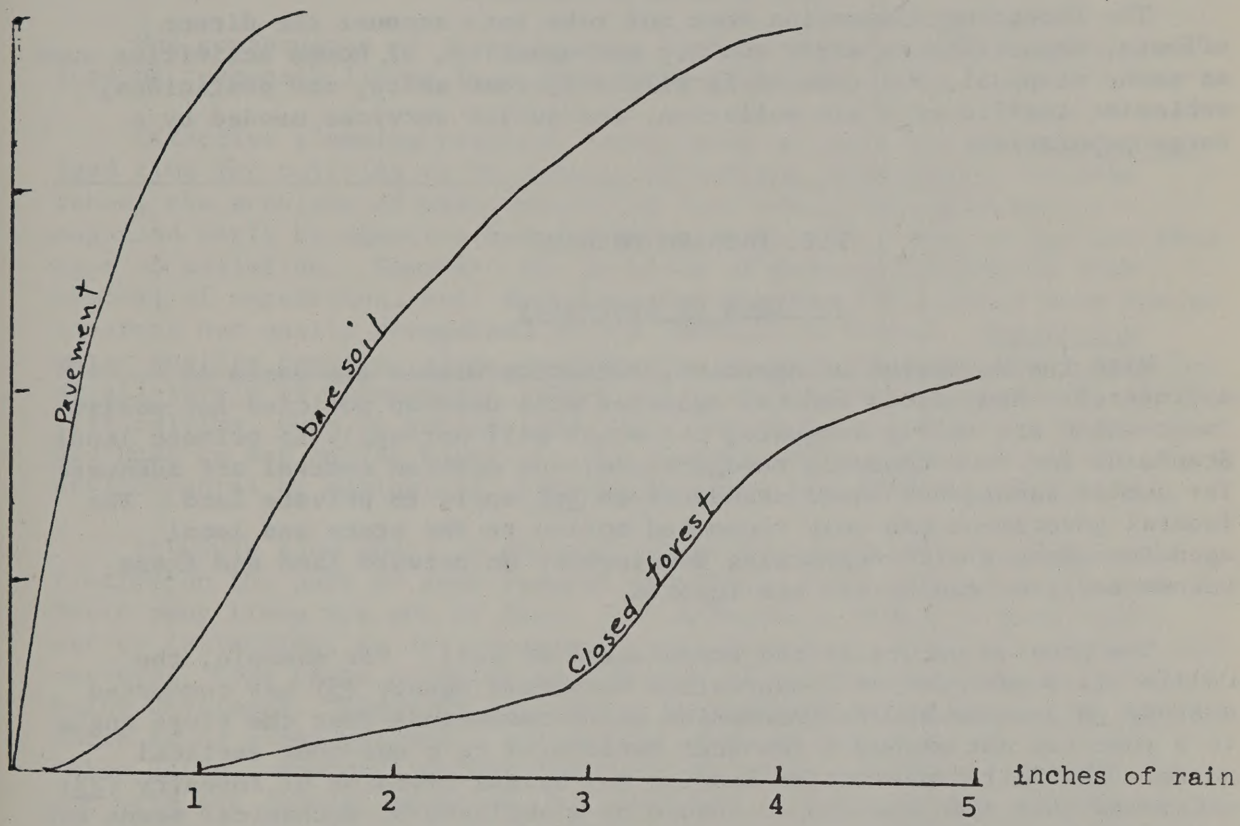

Fig. 2. Diagram reflecting watershed on pavement, bare soil, and closed forest.

Disturbance decreases the spatial diversity and introduces weedy, monotonous species associated with man and his activities.

The environmental impacts can be summarized as follows: on the land, runoff, erosion and gullying are increased with great amounts of minerals leaching from soil and nutrients stored in the vegetation. There is an impoverishment of species of plants and animals by habitat destruction. In the aquatic part of the ecosystem there are changes in drainage patterns with an increase in turbidity, siltation, and inflow of sediment and nutrients into streams and the Lake itself. Consequently, eutrophication accelerates as the increased nutrients allow greater algae growth and the greening of the blue lake waters.

The foregoing discussion does not take into account the direct effects, especially on water quality and quantity, of human activities such as waste disposal, addition of fertilizers, road salts, and pesticides, vehicular traffic with air pollution, and public services needed by a large population.

III. PROBLEM ORIGINS

j. Lack of Authority

With the profusion of agencies, authority within the Basin is splintered. Many times federal agencies will develop policies for public lands which are fairly adequate, but which will not apply to private lands. Standards for tree removal, revegetation, and erosion control are adequate for public lands, but equal standards do not apply to private land. The federal government can only recommend action to the state and local agencies charged with regulating development on private land and these recommendations can be and are ignored.

The problem occurs at the state level as well. For example, the California Department of Conservation Resources Agency (5) has conducted a study on erosion and sedimentation which recommends that the slope angle in a road cut not exceed a two-foot horizontal to a one-foot vertical ratio. The Soil Conservation Service and Nevada Division of Forestry (23) recommend that open cut slopes should be stabilized by mechanical means and revegetation started within the season's operations; road alignments should be planned for a minimum number of cut-and-fill slopes, that is, following the natural contours of the land, and these should also avoid excessive removal of trees and vegetation; slopes should blend at the top of the cut with the natural contours; density of roads should decrease with increasing slope. In recent development all of the above recommendations were ignored. (Photographs).

Similar cases of disregard for adequate environmental precautions which have been recommended can be shown for stream and channel fill and diversions practices; snow removal and accumulation standards; erosion, sedimentation and flood plain hazards; zoning and housing density measures, to cite but a few examples.

k. Inadequate Standards

Many of the standards set for the occasional harsh environmental conditions of deep snows, high winds, and summer drought are not adequate. For example, revegetation in this climate is extremely difficult and a simple one-time application of hydromulch is insufficient. Frosts, rain, and spring run-off and dry summer soils quickly obliterate these efforts. Some building standards are inadequate considering the weight of snow on roofs and sides of buildings.

l. Lack of Coordination

One consequence of there being a large number of agencies with overlapping responsibilities is a lack of coordination.

Effective planning requires recognition of problems with sufficient lead time for policies to be formulated and put into effect. At Lake Tahoe, the problems of water pollution from sewage effluent were recognized early by agencies and effective steps were taken to prevent this type of pollution. However, the problems of nutrient additions from removal of vegetation, soil disturbance and urban development were not so clearcut nor easily recognized by the agencies involved. Preserving water quality requires close coordination between land and water agencies at all levels of government. Once policies have been formulated, there are difficulties, even on public lands, putting them into effect. Officials may have to act on the basis of considerations which are not purely environmental or ecological; competent people and funds are limited.

It would seem that, in general, there is a lack of action and initiative on the part of some federal agencies. Research and studies on the Basin many times are out of date. For example, a recent vegetational survey is lacking, as are adequate descriptive maps, wildlife studies and surveys. Long range planning on the part of federal agencies is just now being developed. Vigorous initiative in land exchange policies is lacking. There is no clear rationale for public land use decisions in the Lake Tahoe Basin. However, except for their inaction, the basic problem lies not with the federal agencies, but with the lack of a total uniform approach to land use and development throughout the Basin, on public and private lands.

IV. ECOLOGICAL AND ENVIRONMENTAL CONSIDERATIONS

m. Environmental Studies and Documentation

Effects on the Basin's aquatic ecosystem were recognized quite early, and since the late 1950's these have been the subject of both private researchers (9, 10, 12) and public agencies (18, 19, 20). Soil studies have been conducted mostly by the Soil Conservation Service. More specific studies initiated recently, such as that by the U. S. Geological Survey on nutrient levels of incoming streams, and continuing studies by Dr. Charles R. Goldman at the University of California, Davis, on the Lake ecosystem and Dr. Robert Twiss at the University of California, Berkeley, on the terrestial ecosystem, attempt to answer specific problems. Many of these studies are in progress, and results are expected within several years.

n. Water Quality and Quantity Studies

Basin-wide, ecological and environmental considerations have been only partly adequate, at best, to assure Lake Tahoe's water purity (10, 13). Some increase in nutrient supply to the Lake, particularly in nitrogen and phosphorus, has been documented by Goldman and Armstrong (12) in the period 1959-60 and in 1967-68. A 50% increase in carbon assimilation indicates greater growth of the minute plants in the Lake's waters. There has been a significant increase in nitrogen, the most sensitive element for Lake productivity. Leggett and McClaren of the Lahoutan Regional Water Quality Control Board (18), predict a three-fold increase in potential nutrient supply under present conditions and a ten-fold increase at the maximum projected population of 250,000 in 2010. They conclude that with refuse and sewage exportation, fertilizer control, and erosion and runoff control, nutrient flow to the Lake will increase only by about 50%. However, they may understate the problem. Their estimate of no increase in nutrients from runoff and streams is unrealistic. Because of breakdown and leakage, sewage treatment and export cannot be 100% effective. Present studies by the U. S. Geological Survey on stream nutrient loads should clarify this situation.

Dr. Goldman emphasizes the need for more adequate long-term measures. Goldman and Carter (9) in 1965, indicated that locally in embayments and around stream discharge into the Lake, pollution was already a problem. Sediment loads and nutrient reserves accumulate on slopes and in stream channels and move only slowly in years of normal runoff and rain. Floods, which have occurred twelve times in the last 90 years, flush large amounts of sediment and nutrients into the Lake. Nutrient buildup is progressive but the supply to the Lake is periodic. The effects of present development in the basin may be known within ten to fifteen years. Estimates, however, can and should be made on potential nutrient sources, particularly from disturbed soils and vegetation.

o. Waste Disposal and Pollution Studies

The need for sewage export was realized before 1950, and sewage and refuse transport are included in most plans for development. In public parks and on beaches, provisions are made for water pollution control in regulating waste disposal, livestock control and stream flow. However, the effects of effluent transport into the closed hydrologic basin around Lake Tahoe on the Nevada side have not been studied.

Recently the need for air pollution and noise abatement procedures have been incorporated into management plans (33). At present, only the needs are recognized; specific regulations should be formulated. For example, controls for trash and litter burning only under favorable atmospheric conditions should be established. Traffic regulation can cut down both air and noise pollution. Noise from construction can be regulated to periods of minimum public use.

p. Forests and Vegetation Studies

Current, up-to-date maps and inventories of the Basin's forest and vegetation resources is a paramount need for managing the Basin.

How much of the Basin's forest, meadow, and brush habitat should be maintained, for example, and in what manner for maintaining esthetic and ecological values? Definite cooperation between the Forest Service, Soil Conservation Service, Bureau of Land Management and Bureau of Fisheries & Wildlife is needed. Research materials from interested ecology groups and from public and private institutions could aid these agencies. At present, definitive studies on the terrestial ecosystems are lacking. Vegetation studies should be coordinated with wildlife and animal studies. Also, the relationship of erosion, nutrient status and runoff to the aquatic system should be recognized.

q. Wildlife and Animal Ecology Studies

Specific studies on animal behavior and habitat, including the movements and patterns of deer, beaver, bear, and larger mammals in the Basin, are seriously lacking. According to studies by Richard Randall of the University of Nevada Biology Department, porcupines pose a serious threat to trees along water. The major effects of the highway and road network on these animals are unknown.

The effect of clearing for ski areas, urban development and the buildup along most of the Lake shore and along the lower stream banks is a drastic alteration of these habitats for both land animals and fish populations. Studies on the number of animals, their movement and ecology and on man's effect on them have not been done.

r. Studies on Climate, Soils, Geology and Hydrology

Abiotic studies on environmental conditions in the Basin provide the basic understanding for effective and wise use of the Basin's resources. Many of the environmental factors are different from those in lowlands and are unique to mountainous basins; these factors must be taken into account in managing the Basin for human use and for ecosystem preservation.

Climate in the Basin is being studied by Harold Klieforth, Desert Research Institute, University of Nevada, in connection with cloud seeding in the Sierra Nevada watersheds leeward to the Tahoe Basin in California. Natural precipitation patterns and amounts vary greatly. Mr. Klieforth maintains that this annual weather variation creates management problems. For example, water for irrigation or snow for ski resorts is unpredictable. The limitations imposed by climatic conditions should be recognized and employed in land-use development planning.

Soil conditions affect road building, construction standards, housing density and watershed management. Virtually every use in the Basin is affected by soils. Personnel at Renewable Natural Resources, College of

Agriculture, University of Nevada, Reno, have studied water penetration and non-wettable soil properties (2, 30) in the Lake Tahoe Basin.

In the past the main causes of destruction were lumbering, fires, and overgrazing. Now, although these activities are restricted, many scars and areas devoid of vegetation and soil are still present. Fortunately, second growth timber now covers most of these areas except at higher elevations and on extremely steep slopes.

Past disturbances on watershed by logging and grazing, (especially on higher elevations) need stabilizing before development can safely proceed below them. Massive sheet erosion damaged roads in Second Creek Drainage in August, 1957 (8), but there was less structural damage than would have occurred had the area been further developed.

Geological hazards in the Basin, e.g. earthquakes, landslides, and avalanches (7), exist as a result of faulting and volcanic activity. Although these natural catastrophies are infrequent, when they do occur they are disasterous. In a mountainous area the frequency of damage is proportional to man's activities; land grading, road building and construction increase the hazards. Development on steep slopes increases land and mud slide hazards for subdivisions below. Recent slides in this area have occurred at Emerald Bay and on the southeast slope of Slide Mountain in Washoe Valley to the east of the Tahoe Basin. The slopes should be stablized immediately.

Hydrologic studies determine the fate of water once on the earth's surface. In Lake Tahoe Basin floods are treated as hydrologic phenomena. Major floods occur in early Winter when warm rains melt previous snow on a frozen soil surface. Local intense flooding results from summer storms on areas above 8,000 to 9,000 feet (8, 23). The intensity of and damage done by both of these types of floods is increased by man's activities.

Consideration of the environmental hazards is just now being undertaken according to a management program (23) by the Nevada Division of Forestry and researchers at University of California at Davis (15). This knowledge has not been incorporated into land-use decisions in Lake Tahoe Basin. Testimony of environment experts at public hearings has been ignored in favor of short-term economic gain at tremendous costs to the environment and the public domain.

More symposia such as the one on Tahoe vegetation soil protection (4) can bring an increasing awareness to the general public and public officials of the complex problems arising from man's activities in the Lake Tahoe Basin.

s. Public Action and Reaction

Public action from organizations such as the League to Save Lake Tahoe and UNSILT (University of Nevada Students Interested in Saving Lake Tahoe) has taken the form of attendance at meetings and testimony. Some Nevada State Legislators from Douglas and Carson City (Ormsby) County in cooperation with concerned organizations have adopted several resolutions aimed at controlling and slowing down development at Lake Tahoe. Since these resolutions have been ignored, lawsuits to stop development have been contemplated in federal courts. Some of these suits are based on the emerging "trust doctrine" (6) which treats public or private users of natural resources as trustees accountable to the public who have an overriding interest in the resources.

At a recent California legislative session, 972 bills were introduced on environmental quality, -- several have direct bearing on Lake Tahoe.

V. ALTERNATIVES AND RECOMMENDATIONS

t. Already Established Guidelines

Many aspects of Lake Tahoe Basin's problems have been recognized for years. The general knowledge for the correction of the problems exists. Only recently, however, has the impetus to do something about them arisen. Immediate steps must be taken to insure that guidelines in current documents (19, 33) and the advice of competent people within federal agencies are heeded, especially in private development decisions which affect landscape integrity, watershed management, water quality and other aspects of the environment on the public domain.

u. Time Limitations Imposed on Development

The pace of development has accelerated not only in response to public demand but also to the fear that restrictions will soon be imposed to preserve the environment and that these environmental limitations will make development more expensive.

This accelerated development must be slowed down and stabilized to minimize impacts on the natural landscape. Small disturbed areas are easier to integrate into the landscape; since the natural ecosystem can stabilize itself to some degree, these can be restored with less human effort.

A "moratorium" has been proposed to stop all development. Time is needed for adjustment of land values, taxation procedures for open space and conservation areas and assessment procedures. A period of two years is needed for these adjustments and three to five years for the effects of the adjustments to be evaluated.

Time is also needed to accumulate scientific and management material for controlling basin-wide development. Until such time as a Regional plan is developed the control can rest in an interim committee as proposed by the Tahoe Regional Planning Company (29) just signed by President Nixon. If land development continues at its present rate during the two years necessary for appointing the Compact Agency and formulating plans, further environmental deterioration will take place.

According to a recent article (1), massive development is already gaining the momentum that could easily spell destruction of the natural landscape and the esthetic appeal of the Lake Tahoe Basin.

Articles (15) by a Norwegian and an Austrian point out the mistakes made by past generations in their long-settled countries and how these problems have been managed. Their problems were created by unwise destruction of forests and native vegetation and required forest practices and unique methods of slope stabilization over mountainous areas. The methods of green construction processes for slope preservation developed in Austria would work almost without modification in the Sierra Nevada. The practice of posting performance bonds in Norwegian forests could be applied to land development procedures in the Lake Tahoe Basin.

v. Implementation of the Tahoe Regional Planning Compact

This regional planning agency (29) provides the means for establishing a truly effective coordinating organization. Adequate staff is provided for, and the Compact Agency has the authority to establish regulations and policies. Its staffing should include competent professionals in a wide variety of fields dealing both with the environment and with human resource management. Implementation has been discussed (14) regarding earlier plans formulated by the Tahoe Regional Planning Commission.

w. Land Exchange Policies

The Planning Agency can provide for establishing priorities in land exchange procedures in order to make effective use of land capabilities. Steep slopes now are being developed which would be better managed as watershed and "green belts." Almost all meadowland along streams is planned for development, but some must be preserved as plant and animal habitat, and, in certain cases, as flood control basins. Other uses can be adjusted to land capabilities.

x. Multiple Use Procedures on Public Lands

Specific examples of coordination needed on public land include the transportation needs of the Basin. Raymond Smith, planning consultant, suggests creating "bottlenecks" of narrow roads which restrict traffic at certain places around the basin. Traffic patterns and flow can only be treated basin-wide.

Special use permits for recreation, logging and change of land status from forest to urban need to be evaluated on a basis that will create the least environmental disturbances. At present, each jurisdiction makes its own use decision based on different criteria.

y. System Analysis Approach to Problem Solving

System analysis is a useful tool for providing answers to large problems on which value judgments can then be made. The complexity of the problems facing the Compact Agency in its planning functions are ideally suited for this basin-wide systems approach. The analysis would concentrate efforts and cut economic loss by integrating functions and avoiding compartmentalization. Benefits would be realized in more effective management and avoidance of costly mistakes.

The systems approach is not cheap. A staff of about 20 professionals would be needed to institute immediate fact gathering at a yearly cost of about $40,000 per professional. Modeling would require four or five people at a cost of approximately $300,000 a year, for a total yearly expenditure of well over a million dollars.

Systems modeling allows the building of predictive models so that the effect of any use decision can be evaluated prior to other uses and systems throughout the Basin. In particular, rate function of processes in units per time can be handled by systems analysis.

Truly regional planning would also take into account the effects of the Tahoe Basin policies on surrounding regions. Transport of effluent in the closed hydrologic basins in Nevada needs to be examined. The use of low cost housing on surrounding, less expensive land has been proposed. Certain features such as the study of the hydrology of Truckee, Carson, and Walker River watersheds have been proposed on a region-wide basis.

z. Change in Attitude

Finally, a fundamental change is required in our attitudes about the Basin's basic resource and its significance for the needs of future generations. Twenty years from now a relatively undisturbed and unexploited Basin may be invaluable. The idea of adapting humans to the resources offered by Lake Tahoe Basin, of slowing development to a pace at which human use and the natural landscape develop in harmony, has overwhelming appeal.

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APPENDIX I

Series of photographs
of Lake Tahoe Basin and
related problems

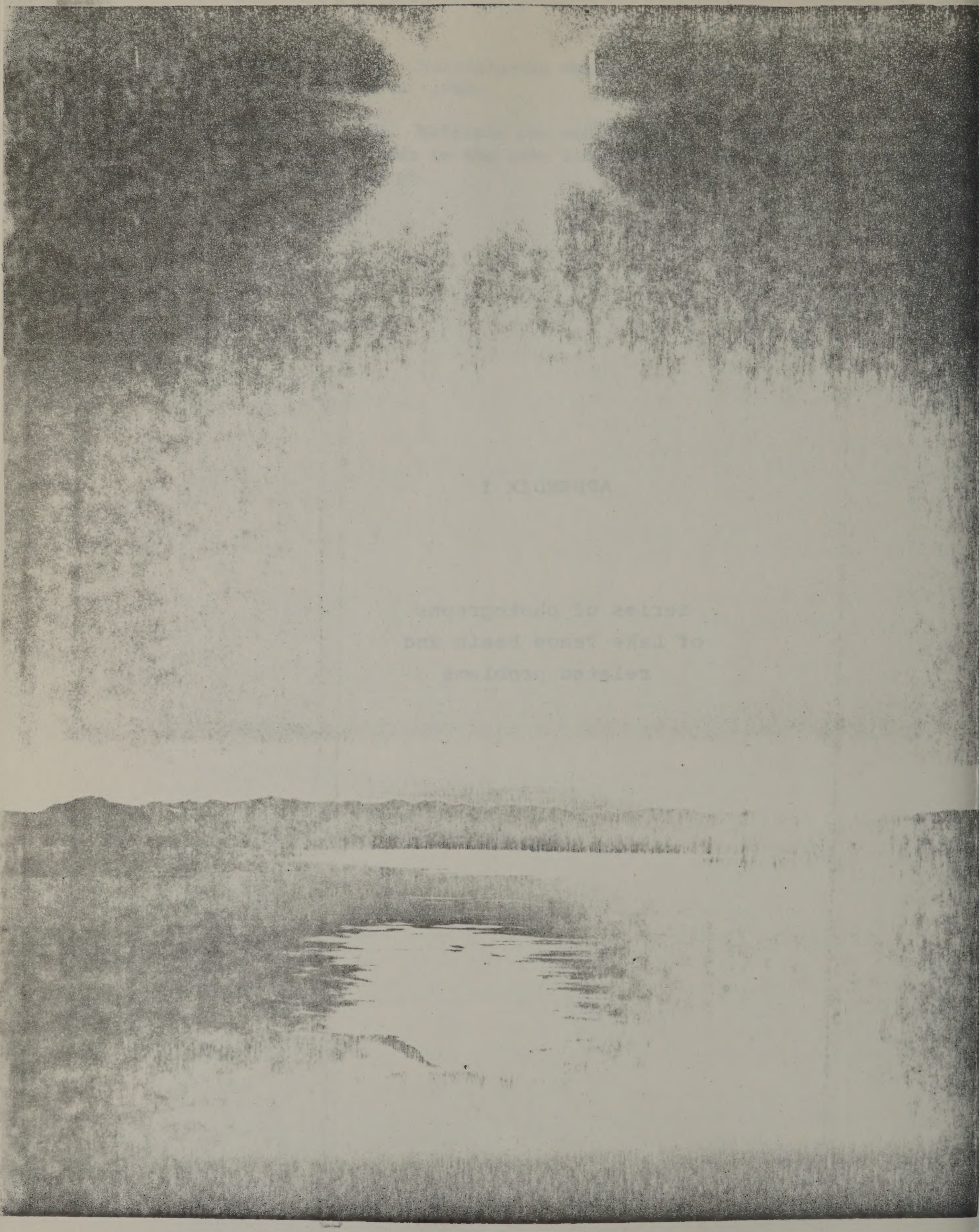
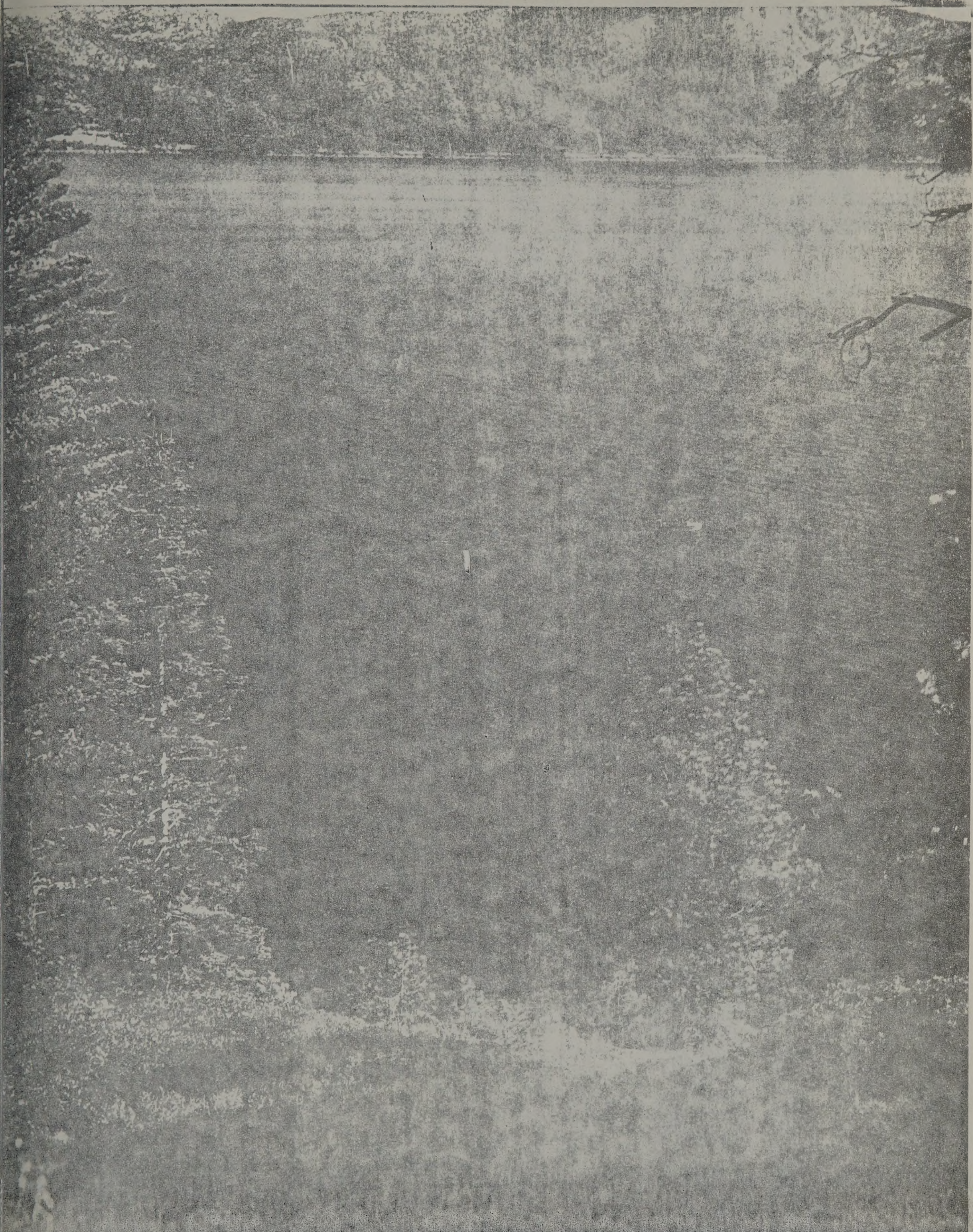
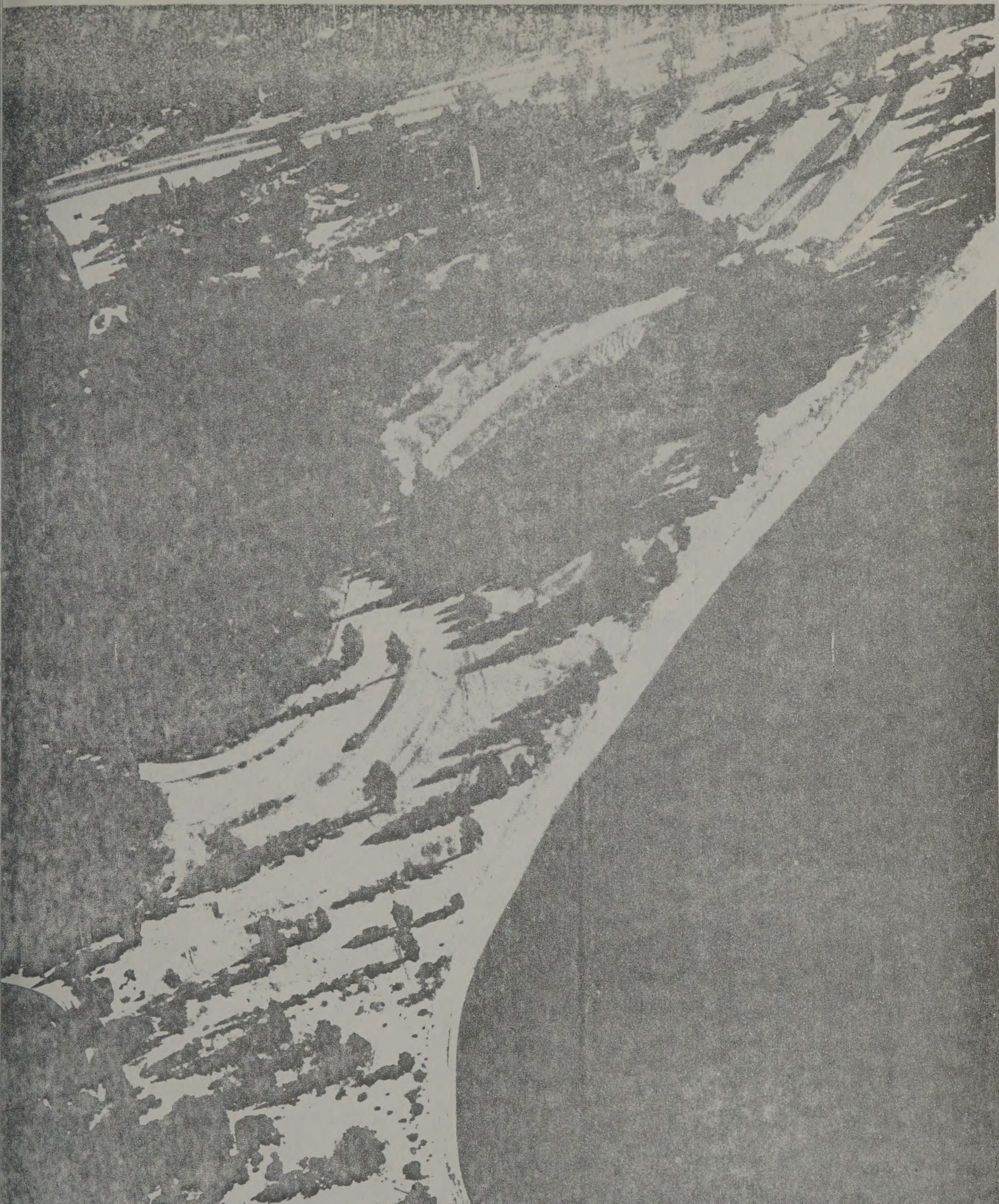


Photo 1. Lake Tahoe from Incline Village looking west across Crystal Bay. A smoky inversion layer is visible in the lake background. December 7, 1969.



hoto 2. Crystal Bay in the northeast portion of Lake Tahoe demonstrates the clarity of Tahoe's water. December 7, 1969.

Photo 3. South Lake Tahoe viewed from the north end of the lake lies under a blanket of smoke. December 7. 1969.



oto 4. Sand Harbour on the Nevada side of the lake caused controversy over the cutting of trees and development of parking facilities. November 29, 1969.

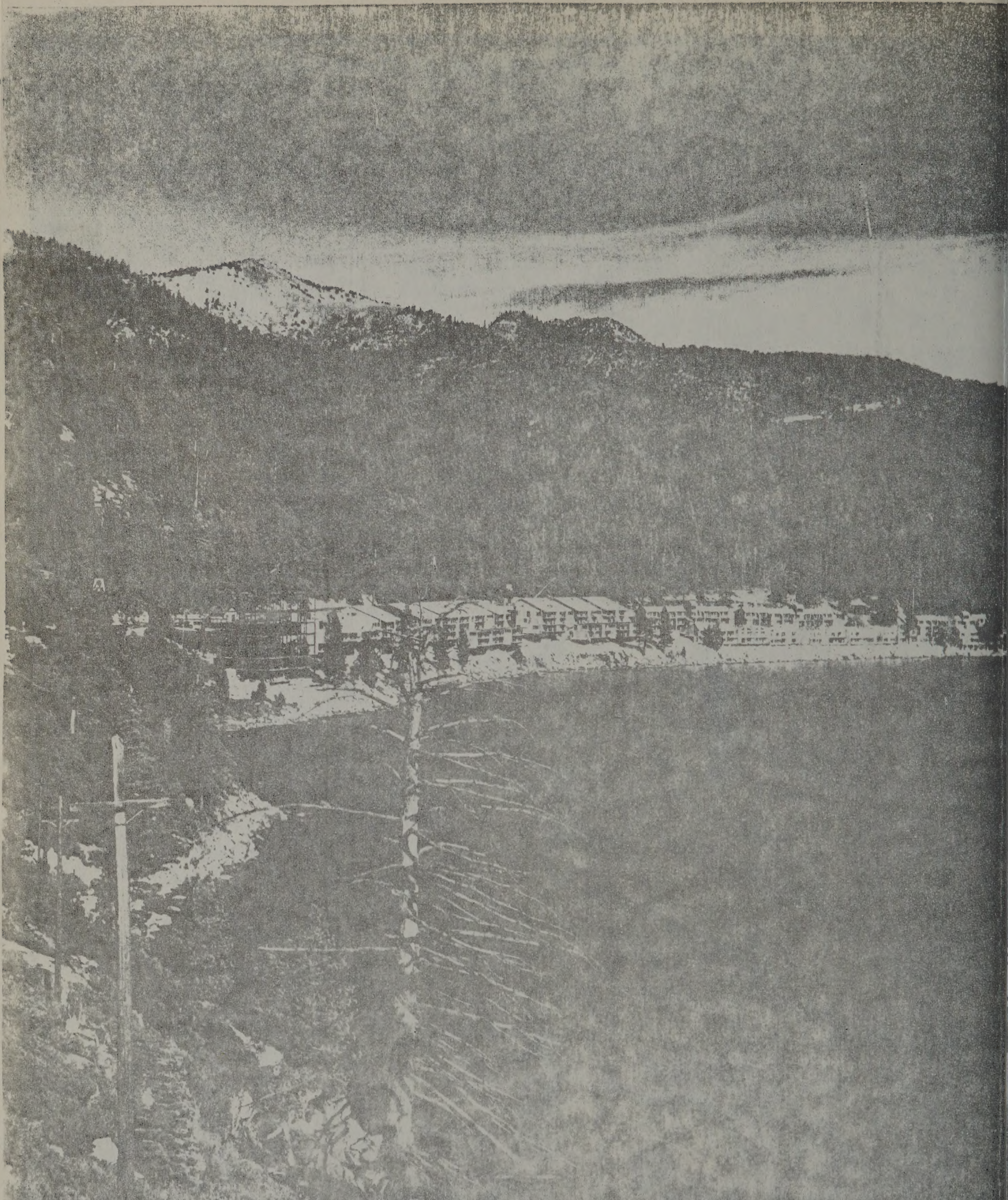
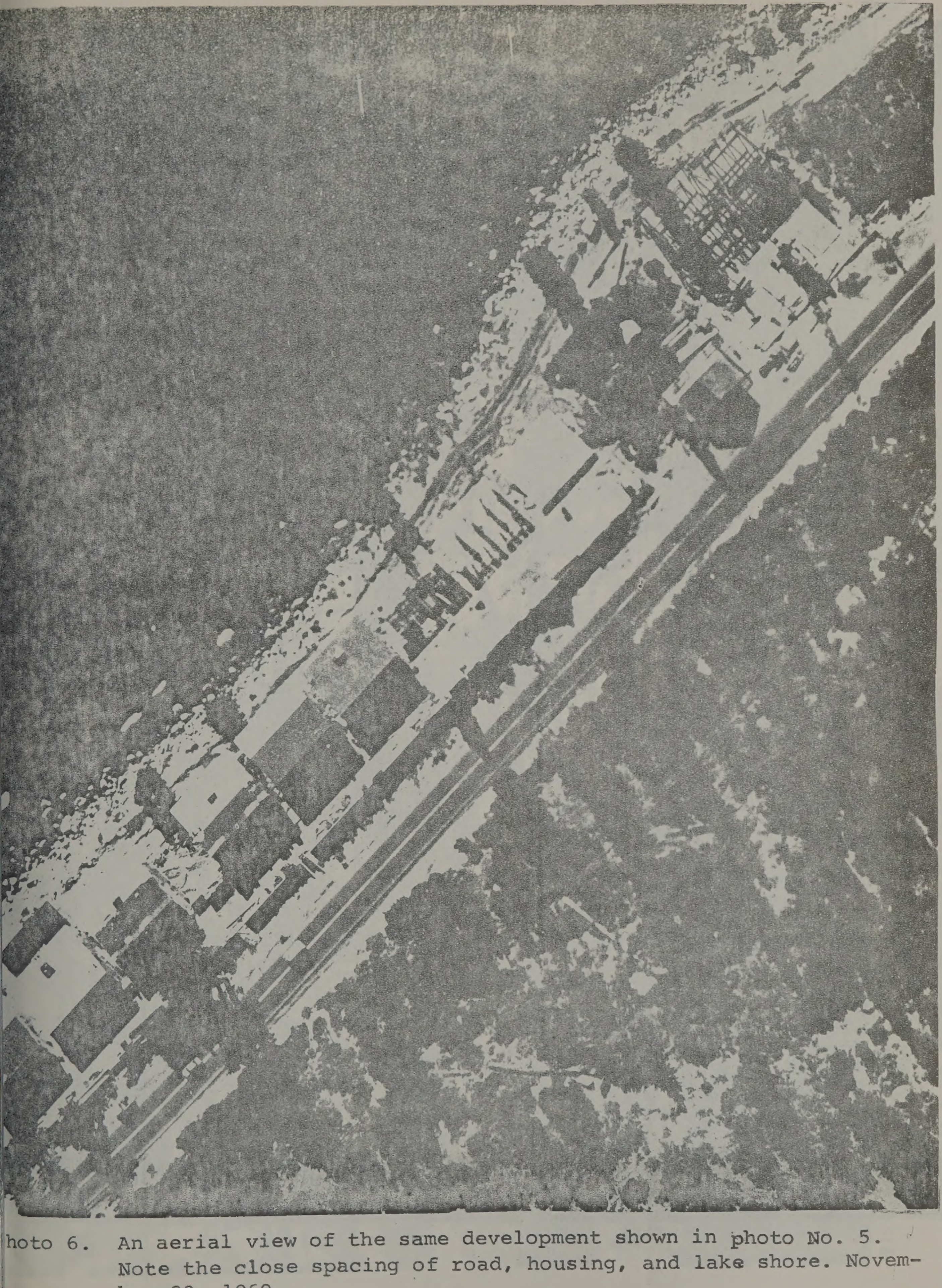


Photo 5. High density housing oı the north shore of Crystal Bay. December 7, 1969.



hoto 6. An aerial view of the same development shown in photo No. 5. Note the close spacing of road, housing, and lake shore. November 29, 1969.

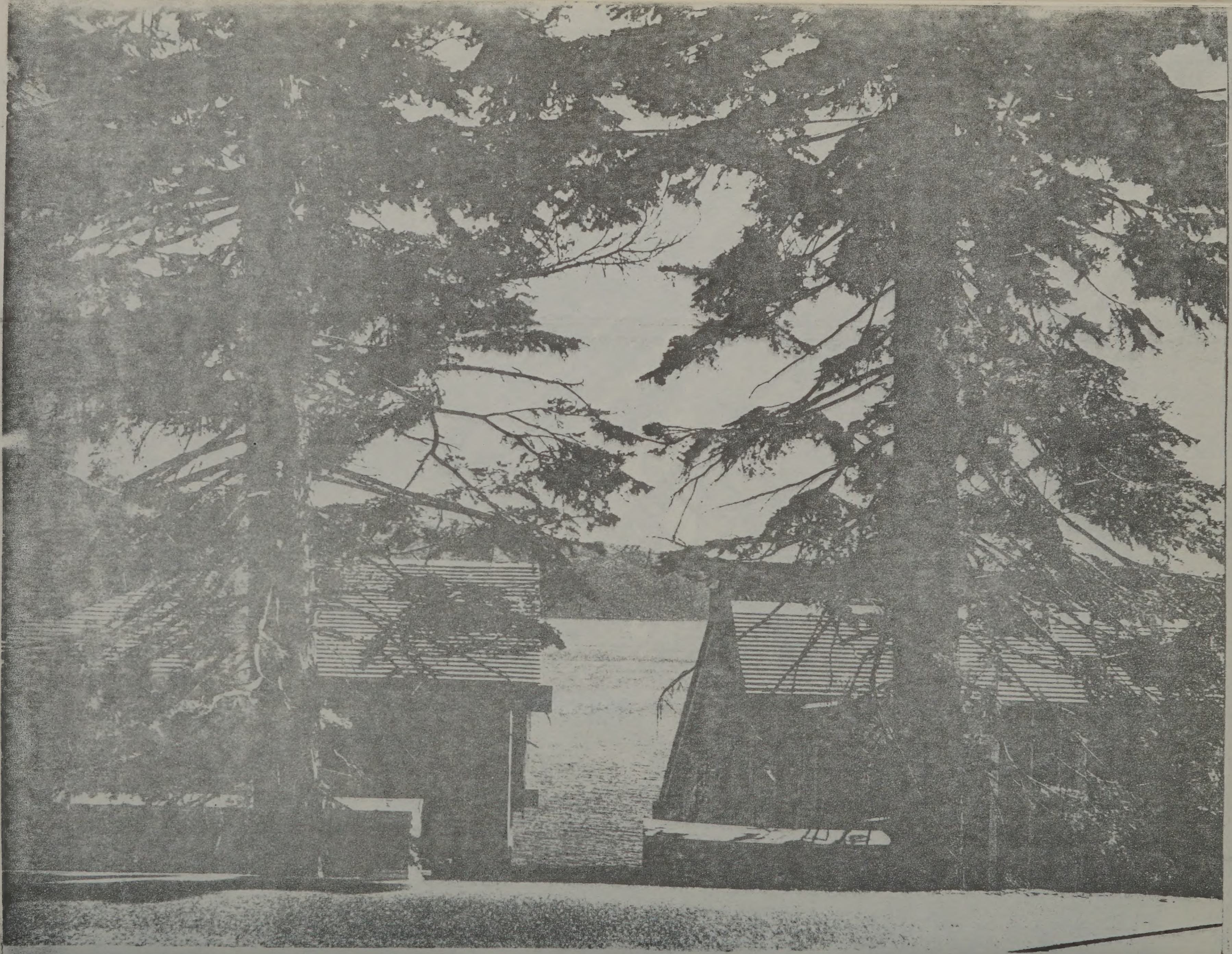


Photo 7. The housing development shown in photo No. 6 completely obscures any view of the

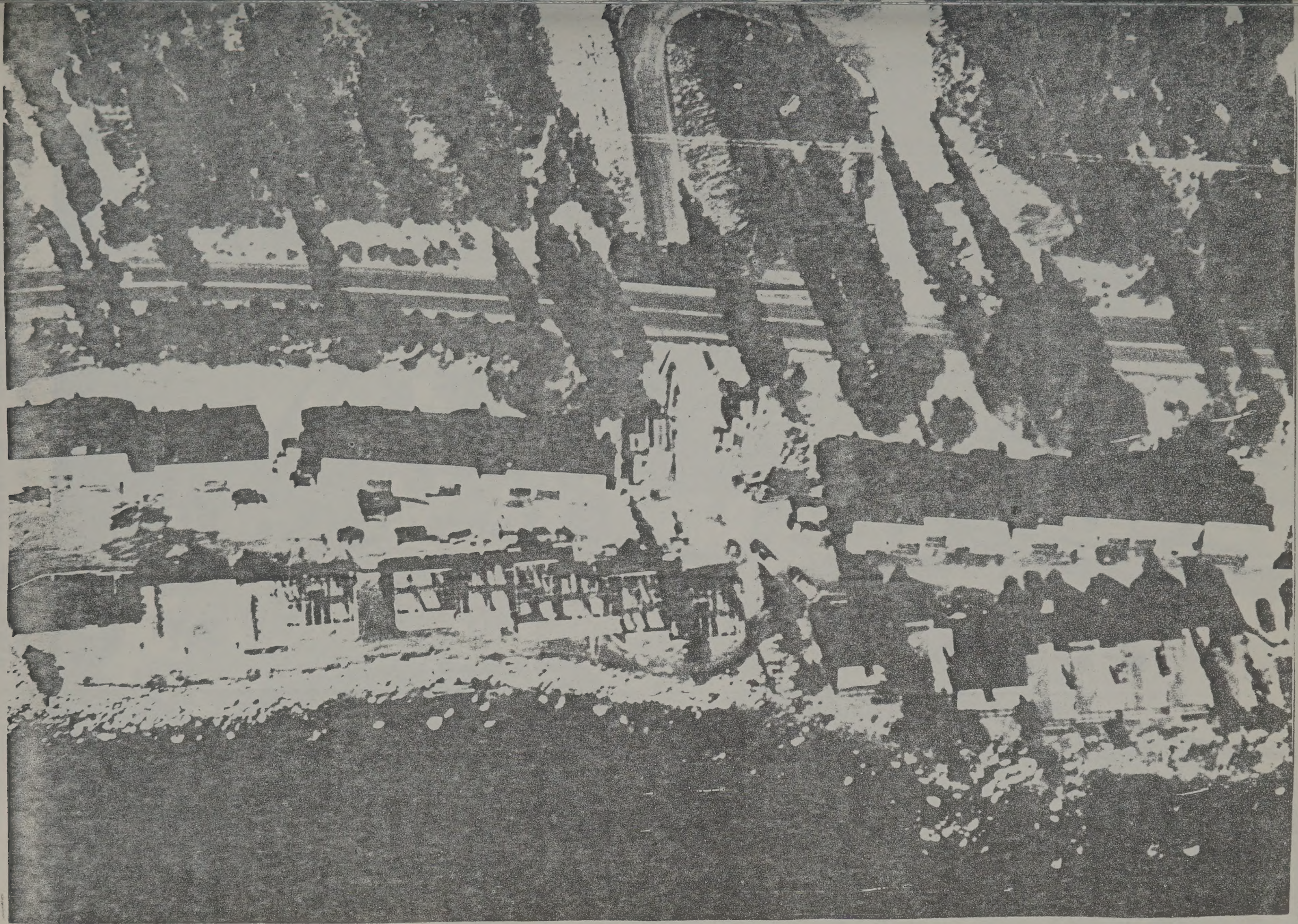
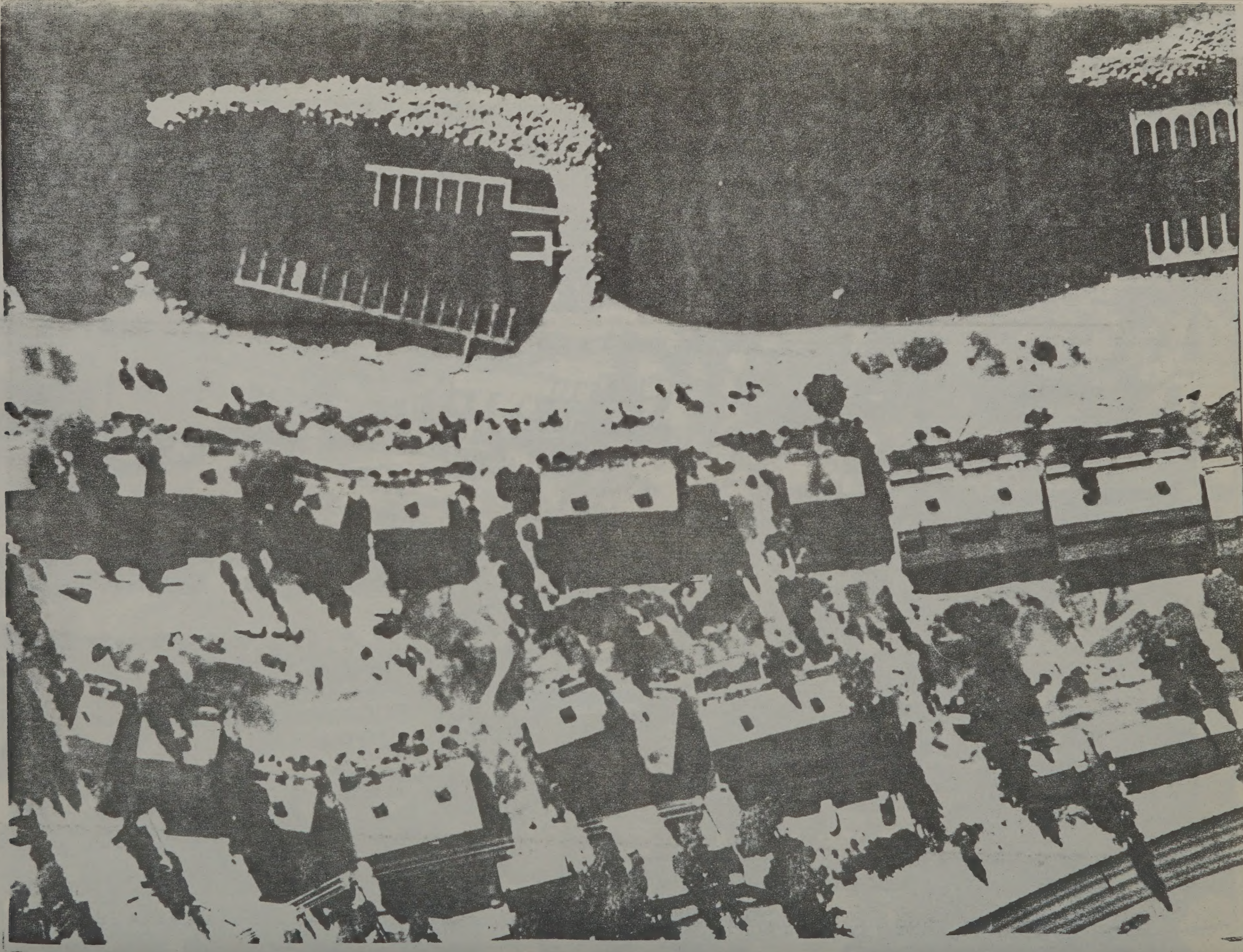
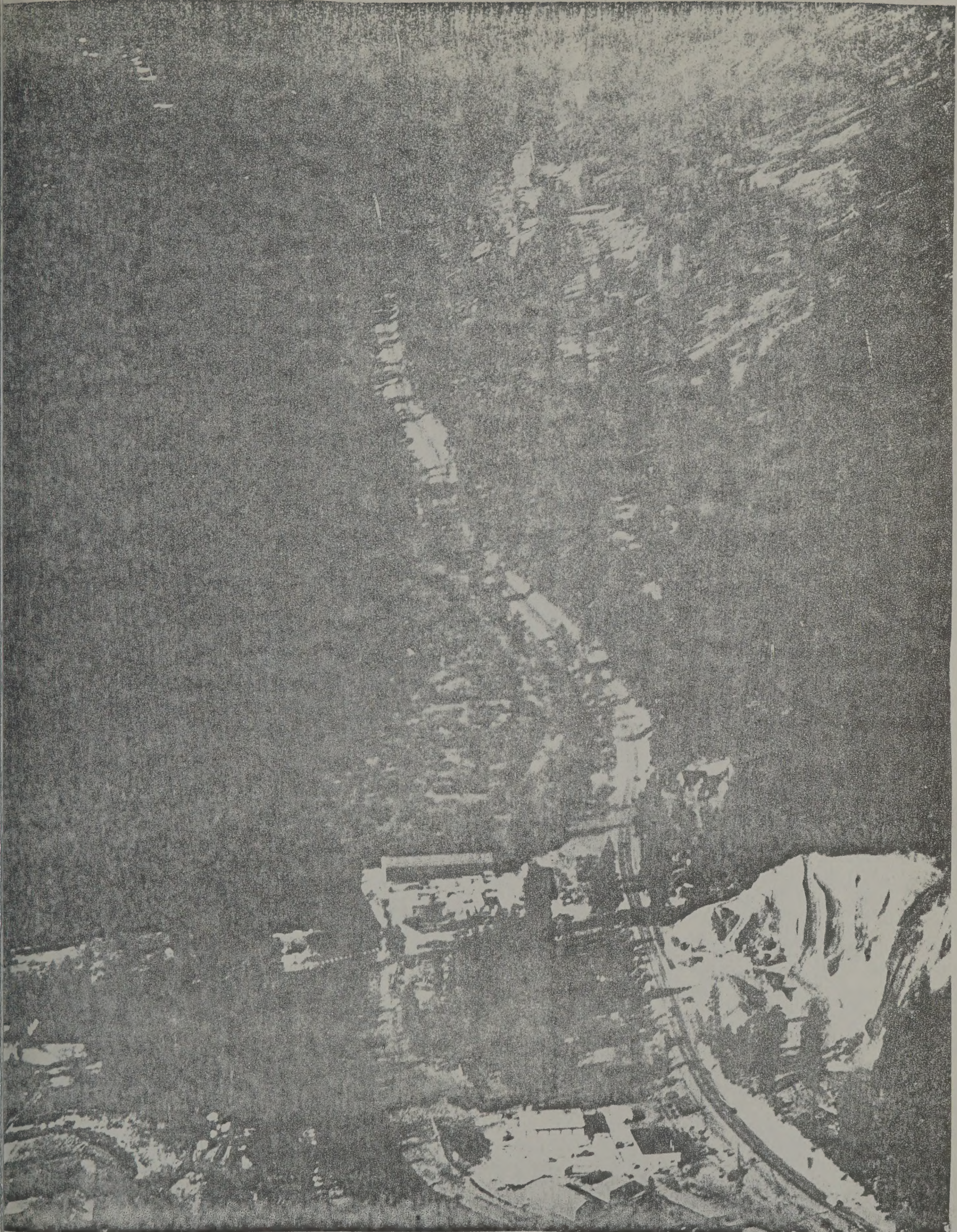


Photo 8. An aerial view of the housing development in photo No. 7 farther east along the shore. November 29, 1969.



[illegible] development along Crystal Bay, November 29, 1969



oto 10. Unsightly gravel materials stored along the road at the exit of the Truckee River. November 29, 1969.

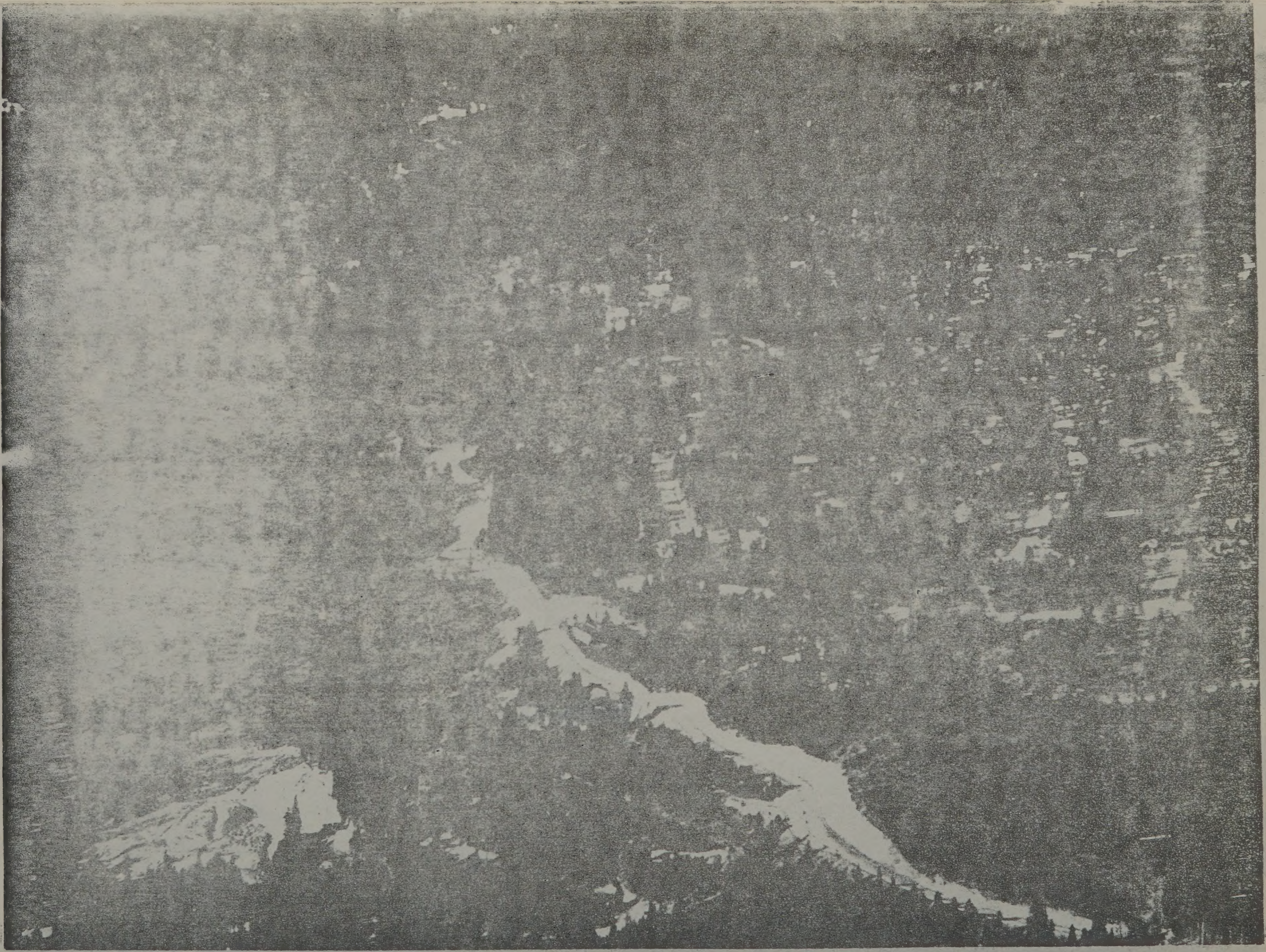
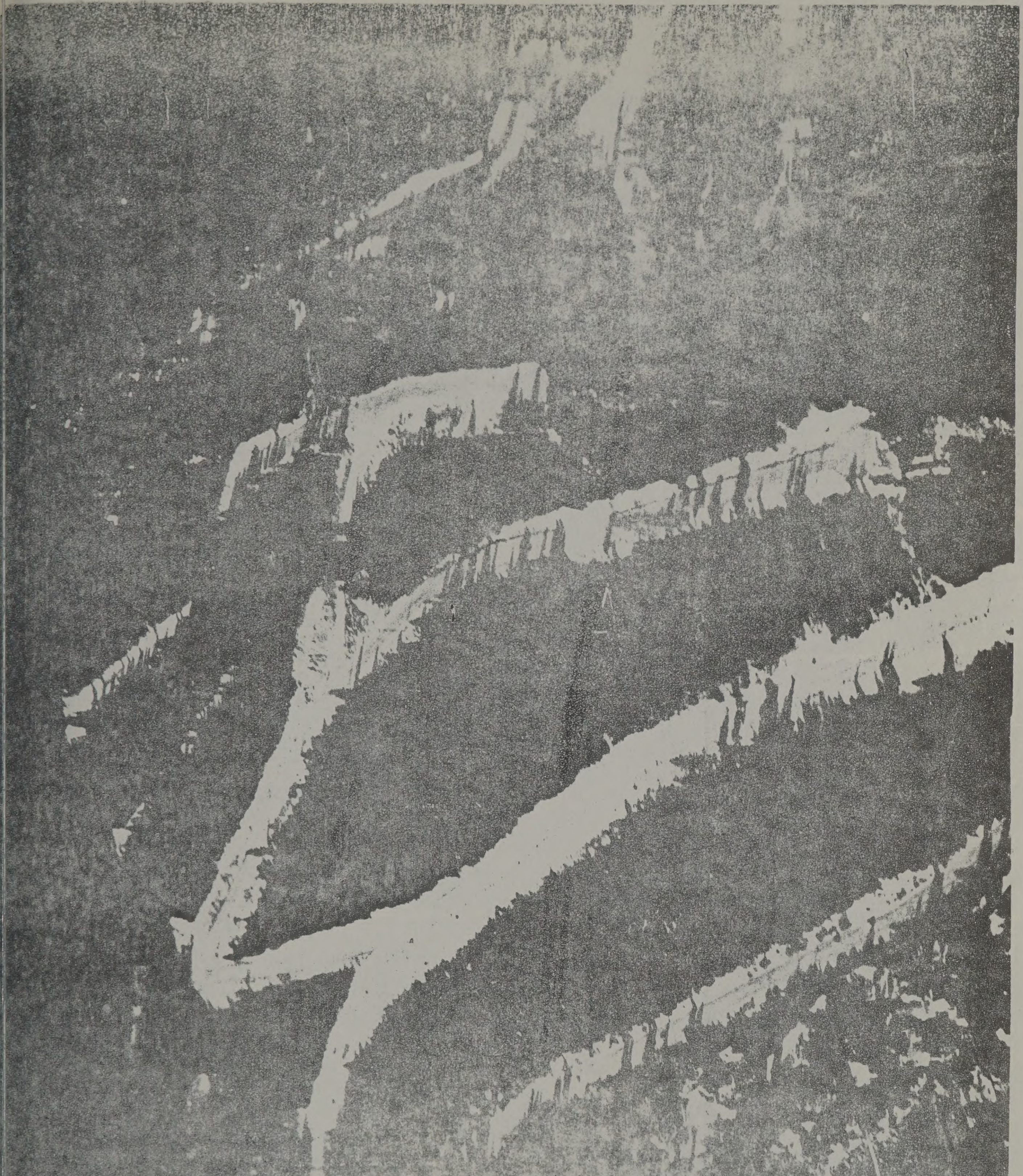
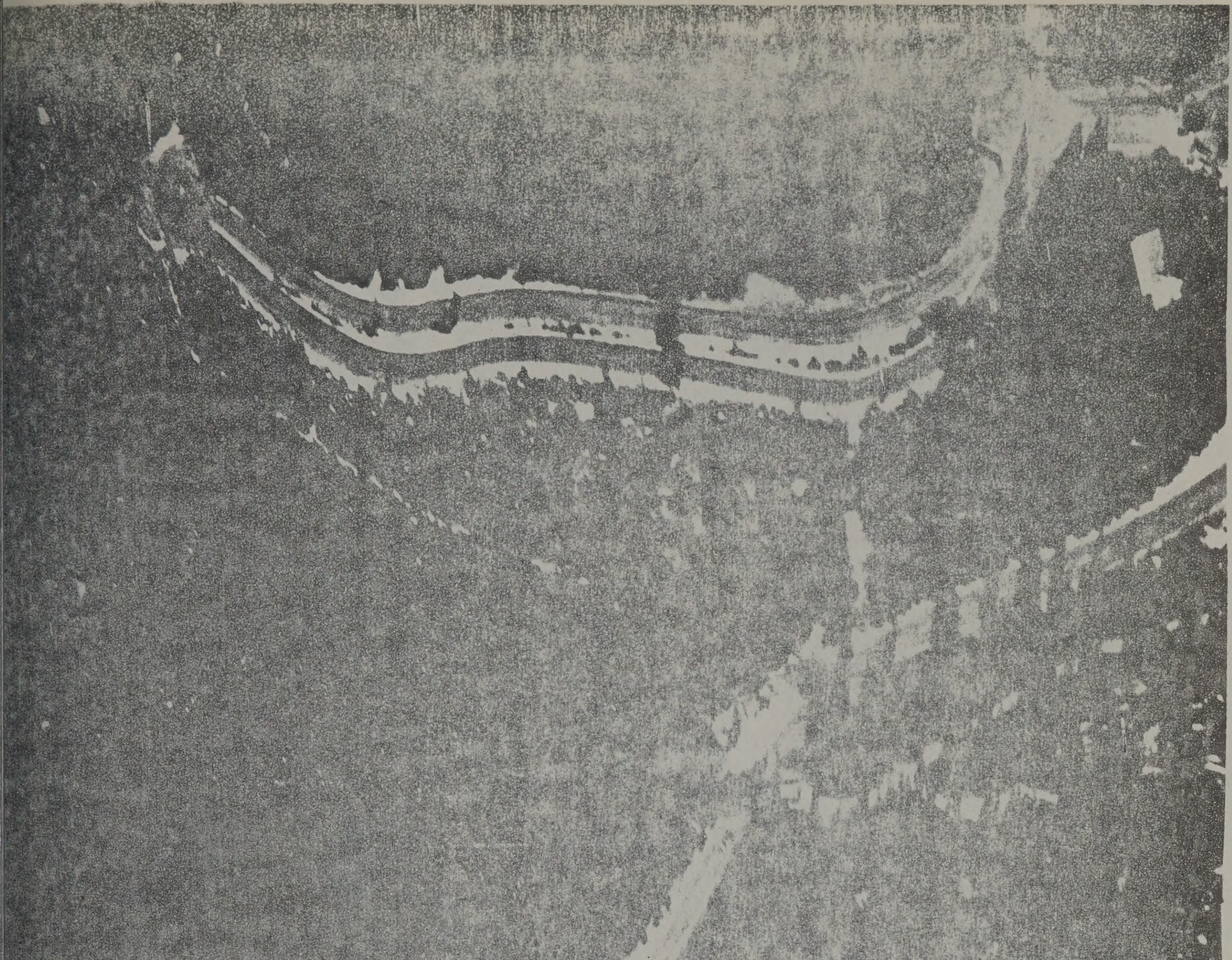


Photo 11. Land development along the west shore. November 29, 1969.



hoto 12. Road cuts in unstable soils along the west shore. November 29, 1969.

Photo 13. Further land development along the west shore. November 29, 196



oto 14. A double road graded into an area where the absence of trees indicates loose, erodable soils. November 29, 1969.

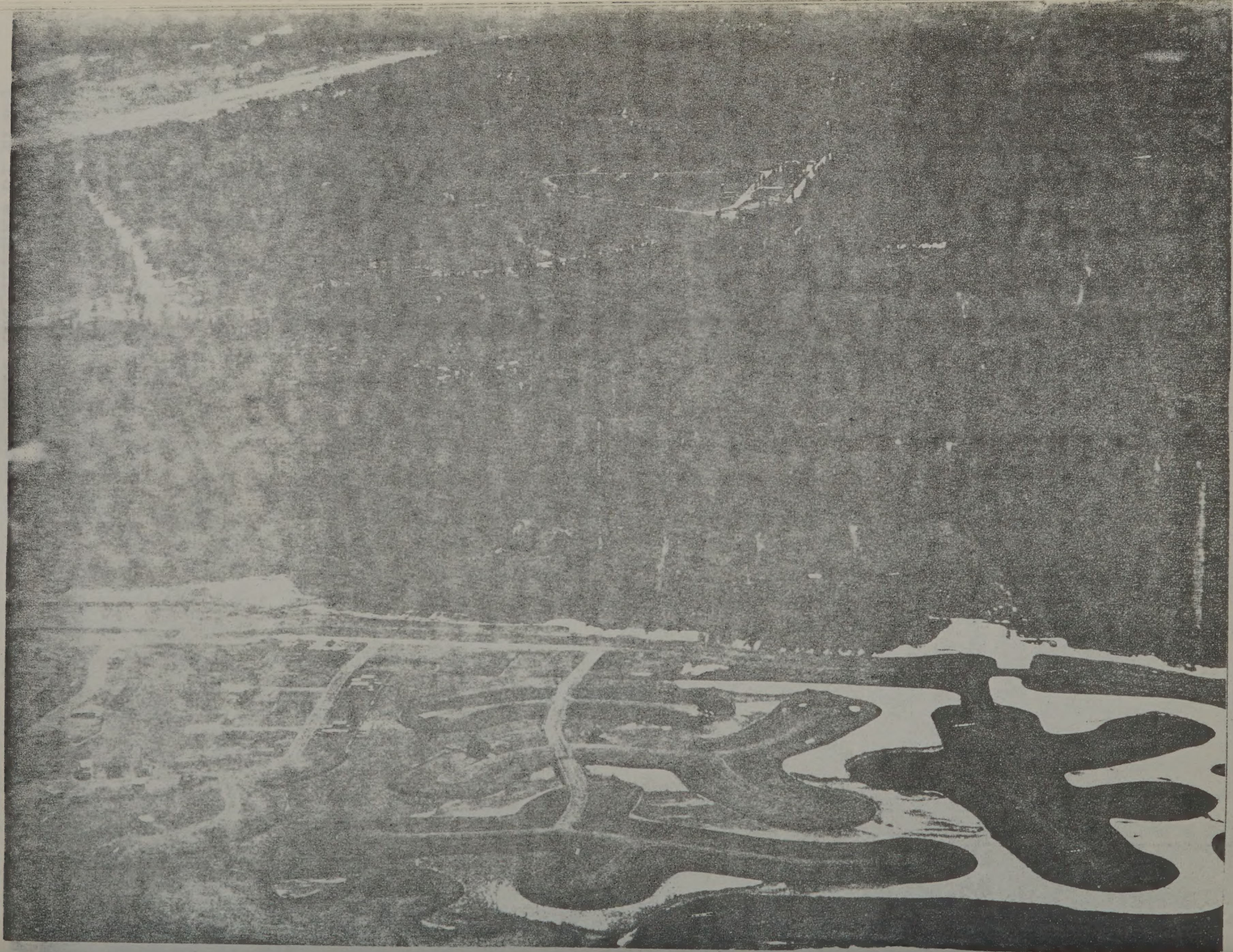


Photo 15. Lake fill at the south end of Lake Tahoe has created lagoons in which
circulate freely into the lake. November 29, 1969.

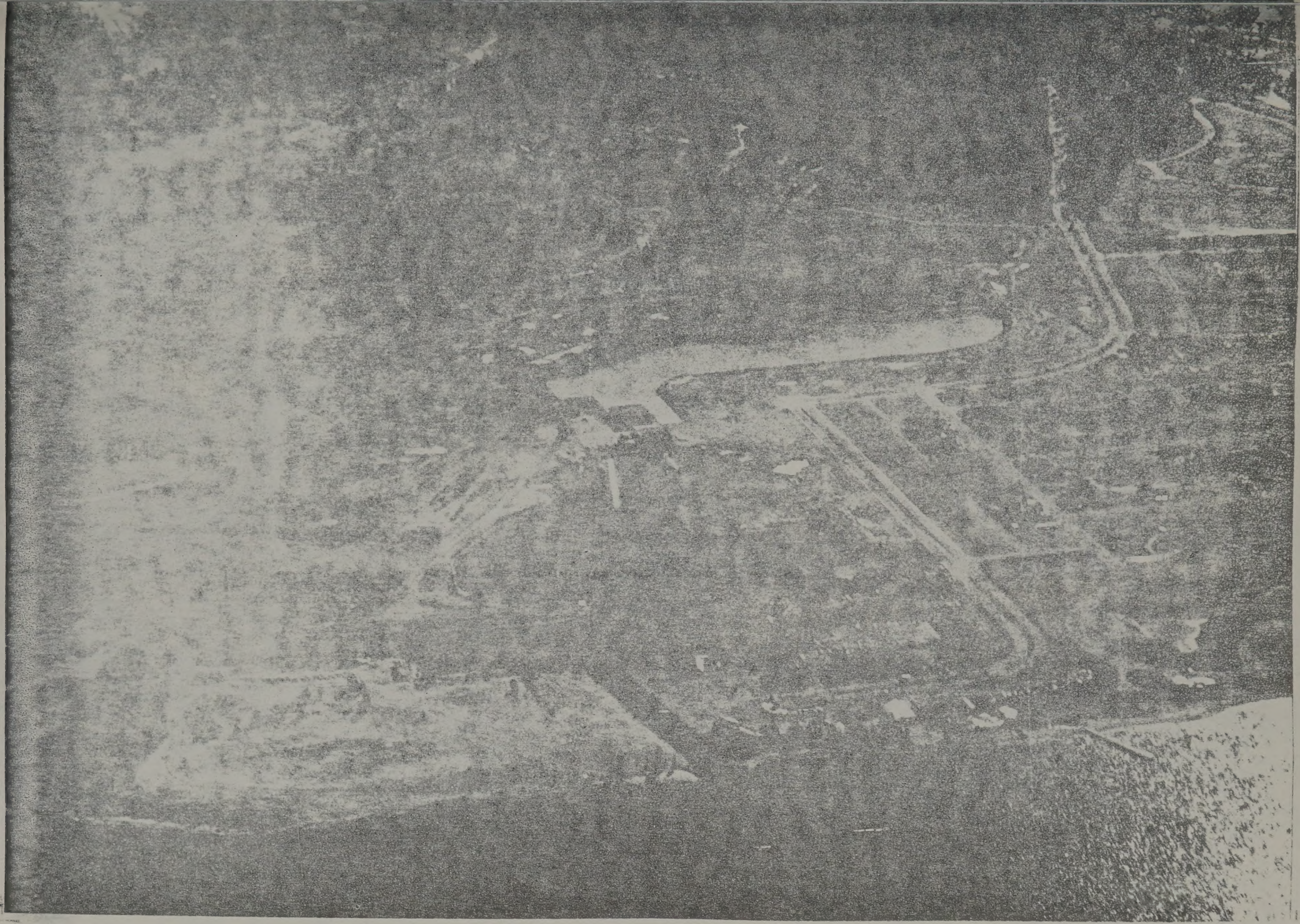


Photo 16. Marina development at the mouth of the Upper Truckee River has altered the natural drainage patterns. November 29, 1969.

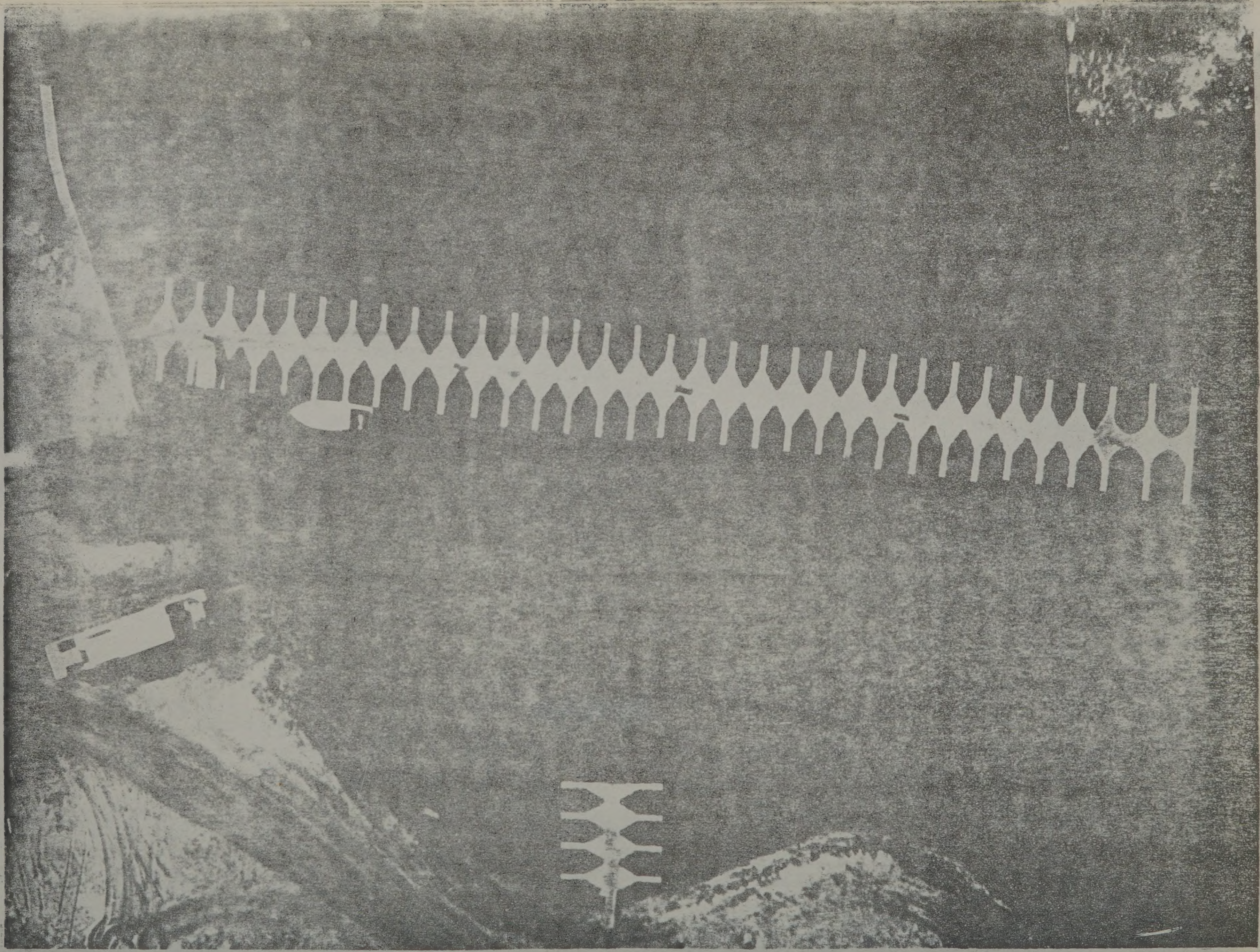


Photo 17. The embayment created by altering the outlet to the Upper Truckee River shown in

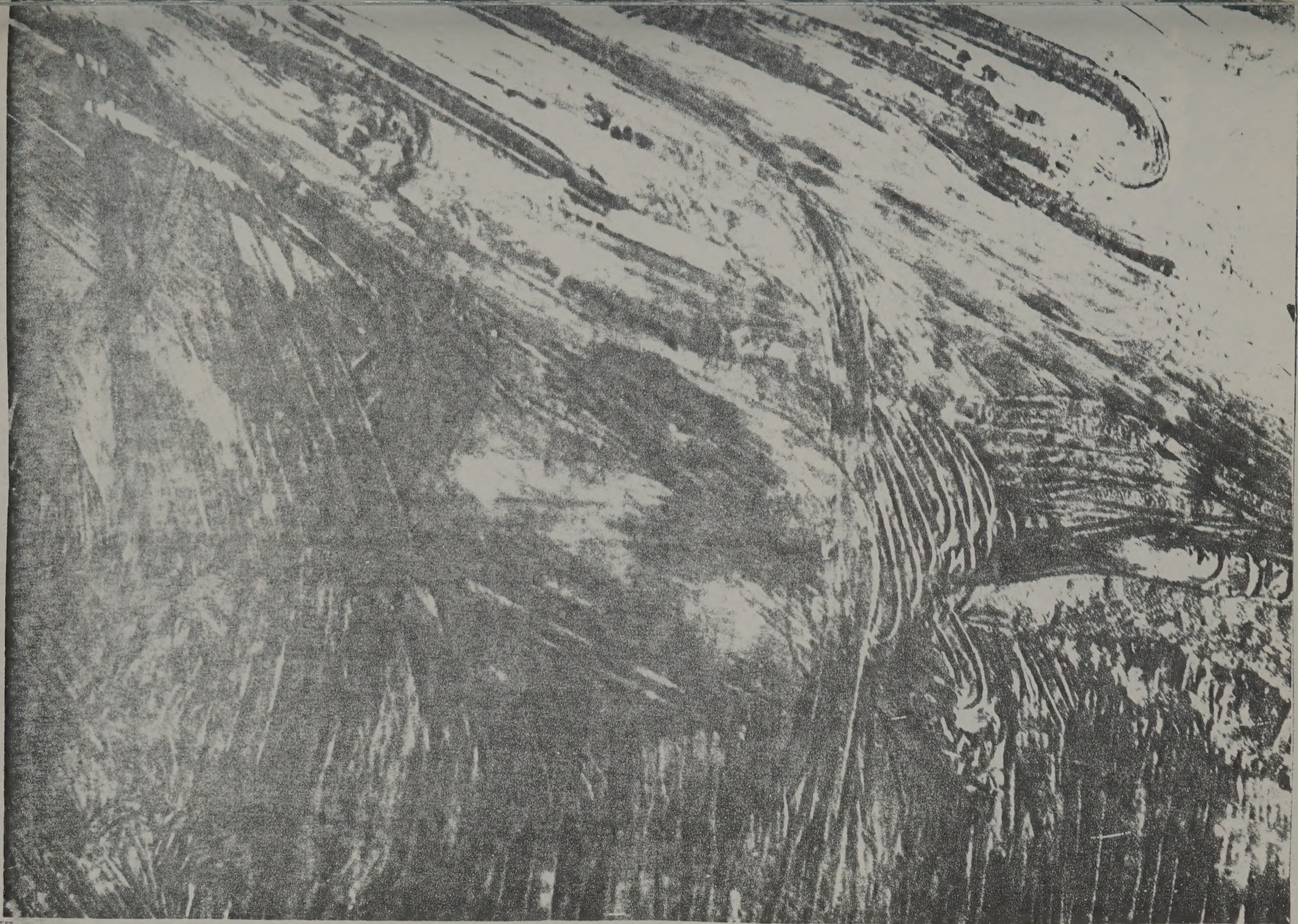
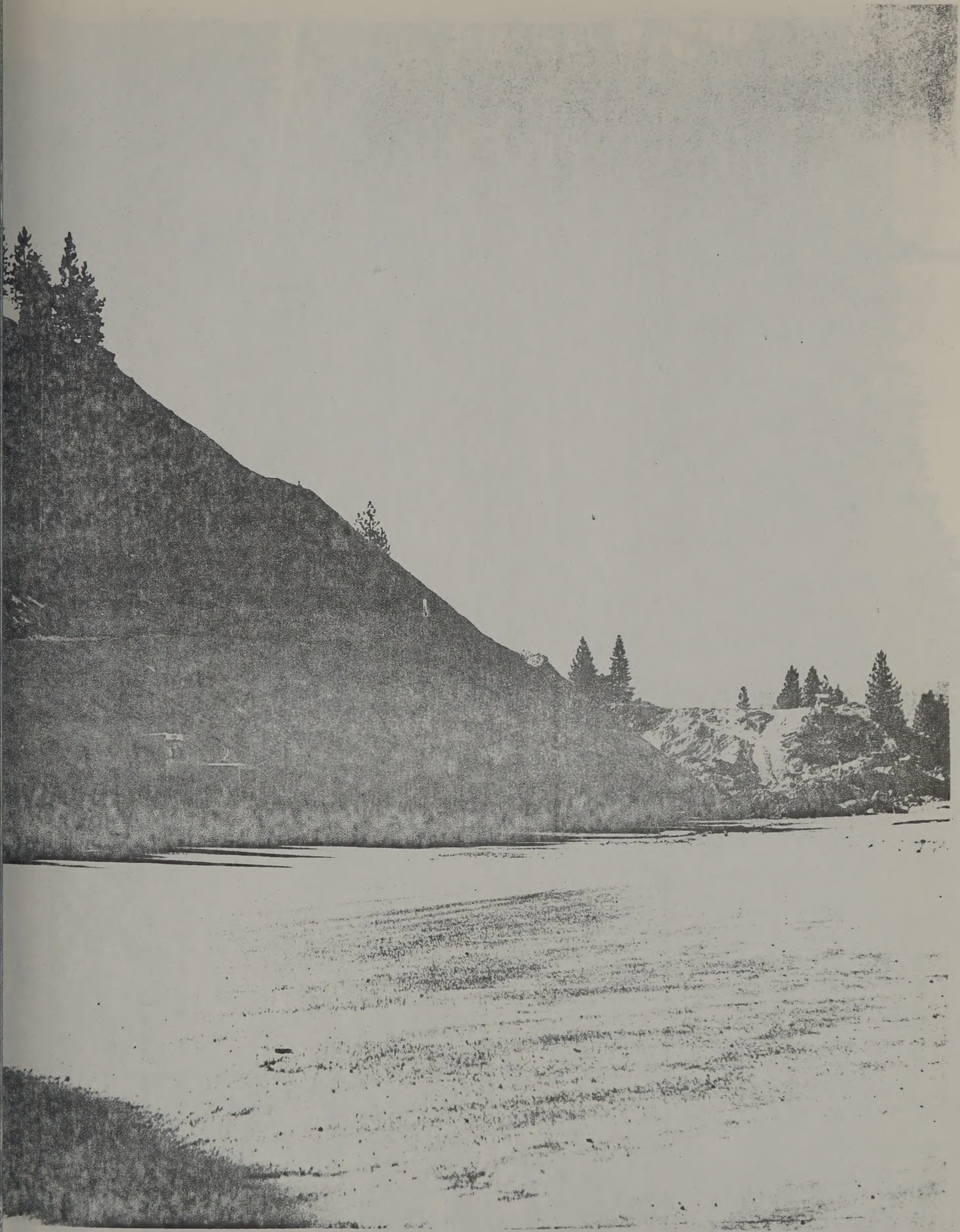


Photo 18. Dredge and fill activity around the mouth of the Upper Truckee River shown in photo No. 17. This flat area is susceptible to flood causing sedimentation into Lake Tahoe from the bare, unvegetated soil. November 29, 1969.

Photo 19. Road construction below Ski Incline area in the Incline Villa development. Road cut in the right center is shown in the ne t two photographs. November 29, 1969.



oto 20. View of the extreme roadcut and fill shown in photo No. 19 that could have been avoided by rerouting the road. This steep, north-facing slope is difficult to stabilize and revegetate. December 7, 1969.

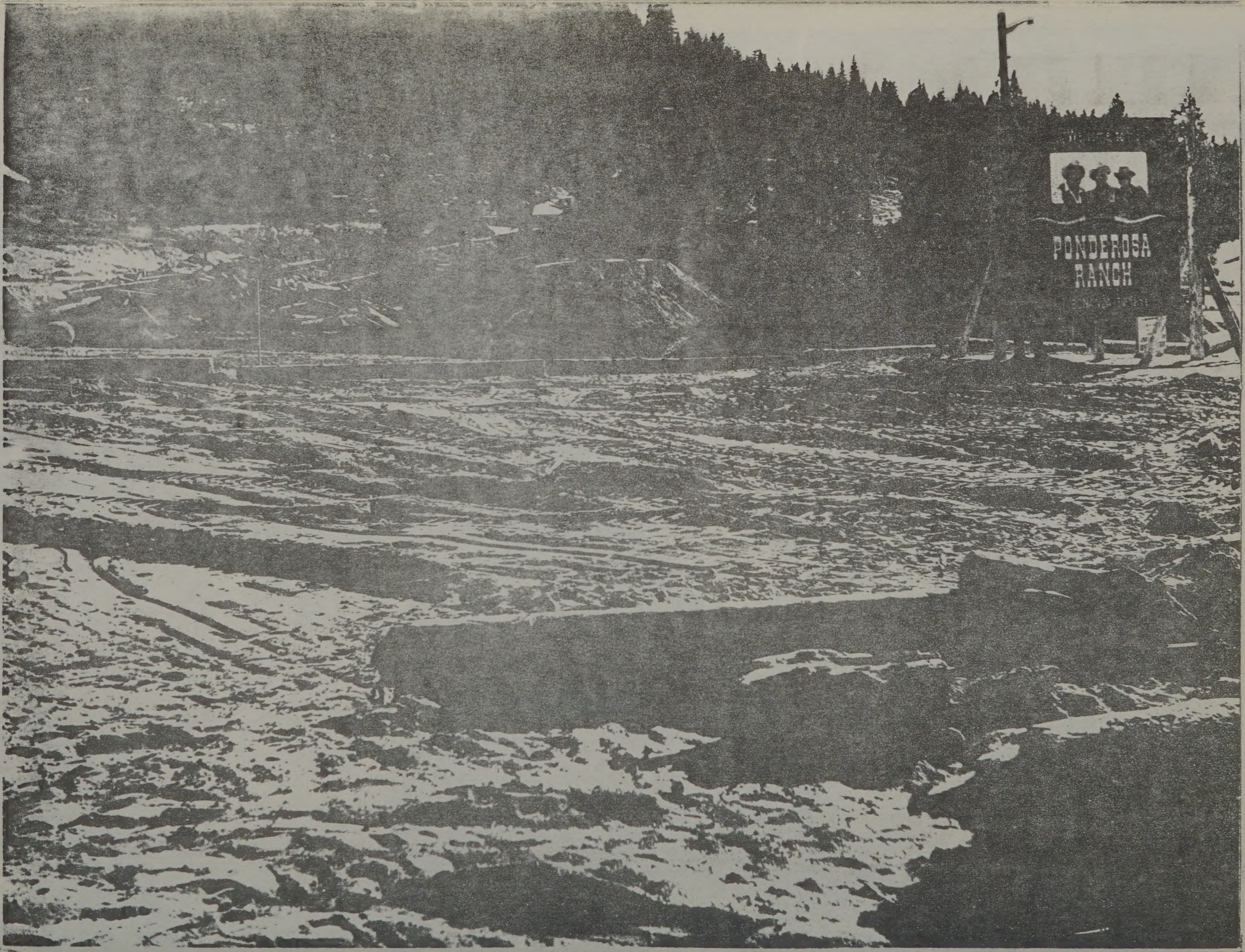


Photo 21. Recent clearing and land fill at Incline Village. Logs and top soil removal flush nutrients into nearby streams and lake. December 7, 1969

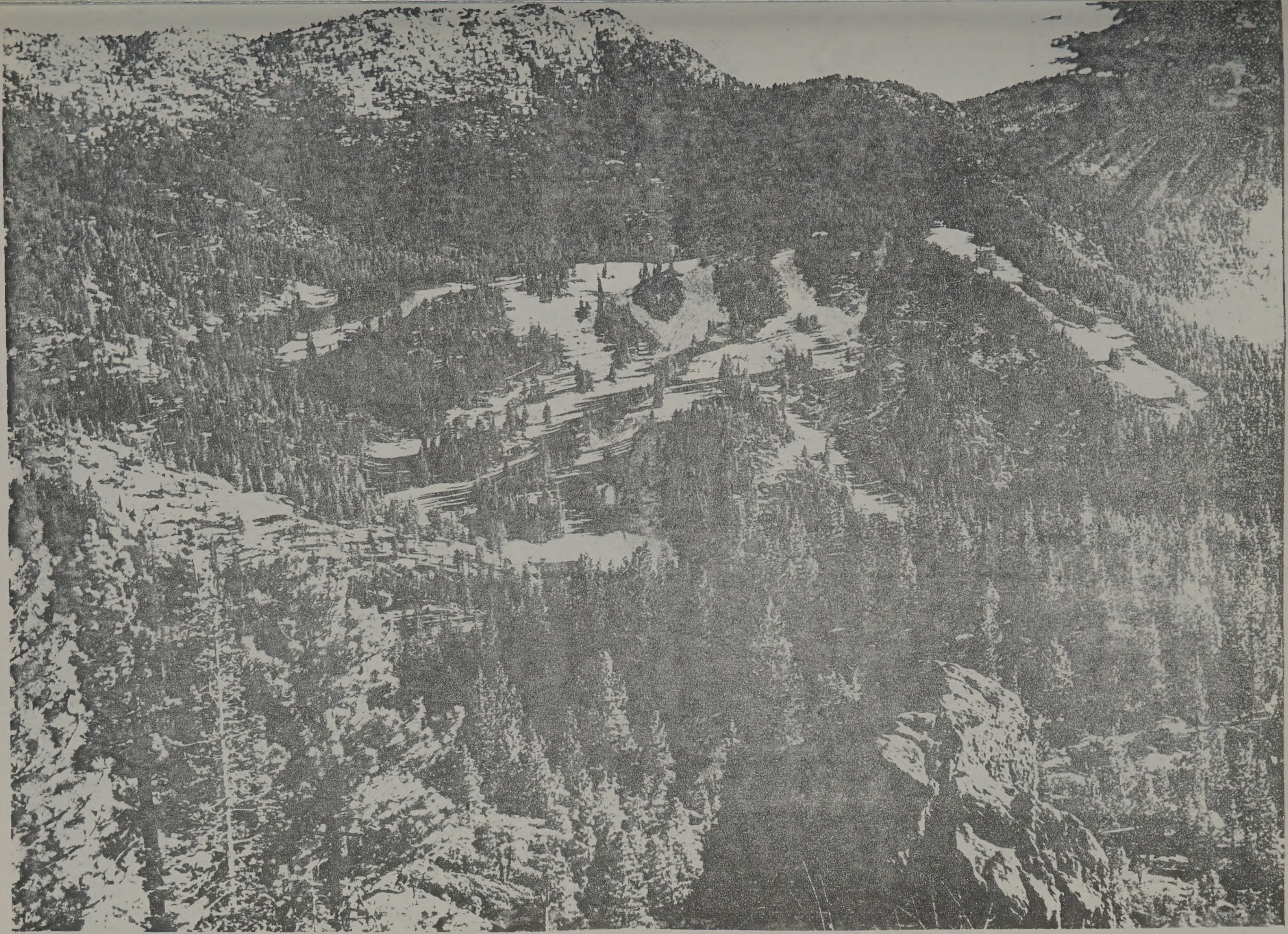


Photo 22. Ski Incline has caused disruption of stream drainage through this area. December 7, 1969.

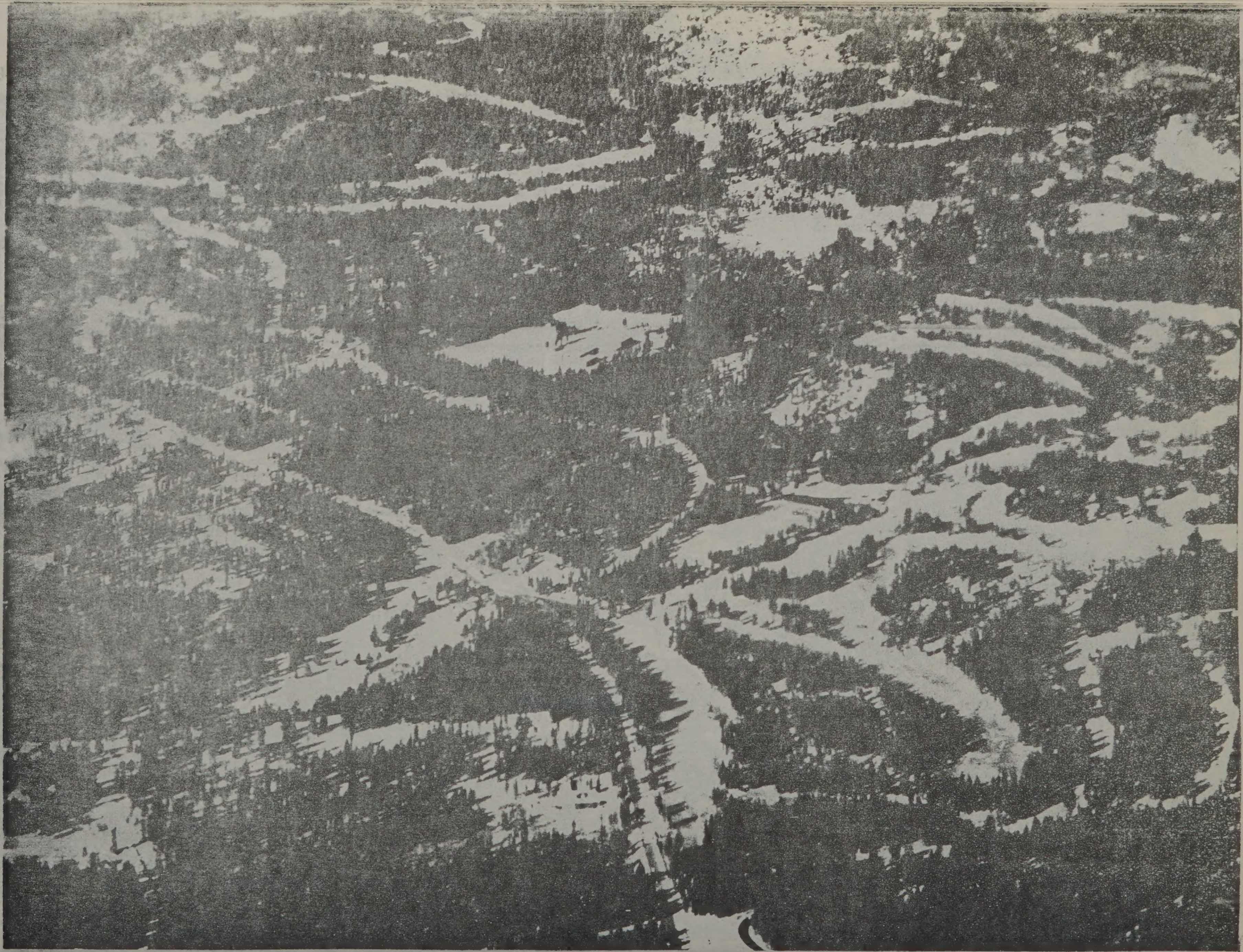


Photo 23. At the Incline Village development, grading for a second golf course has narrowed

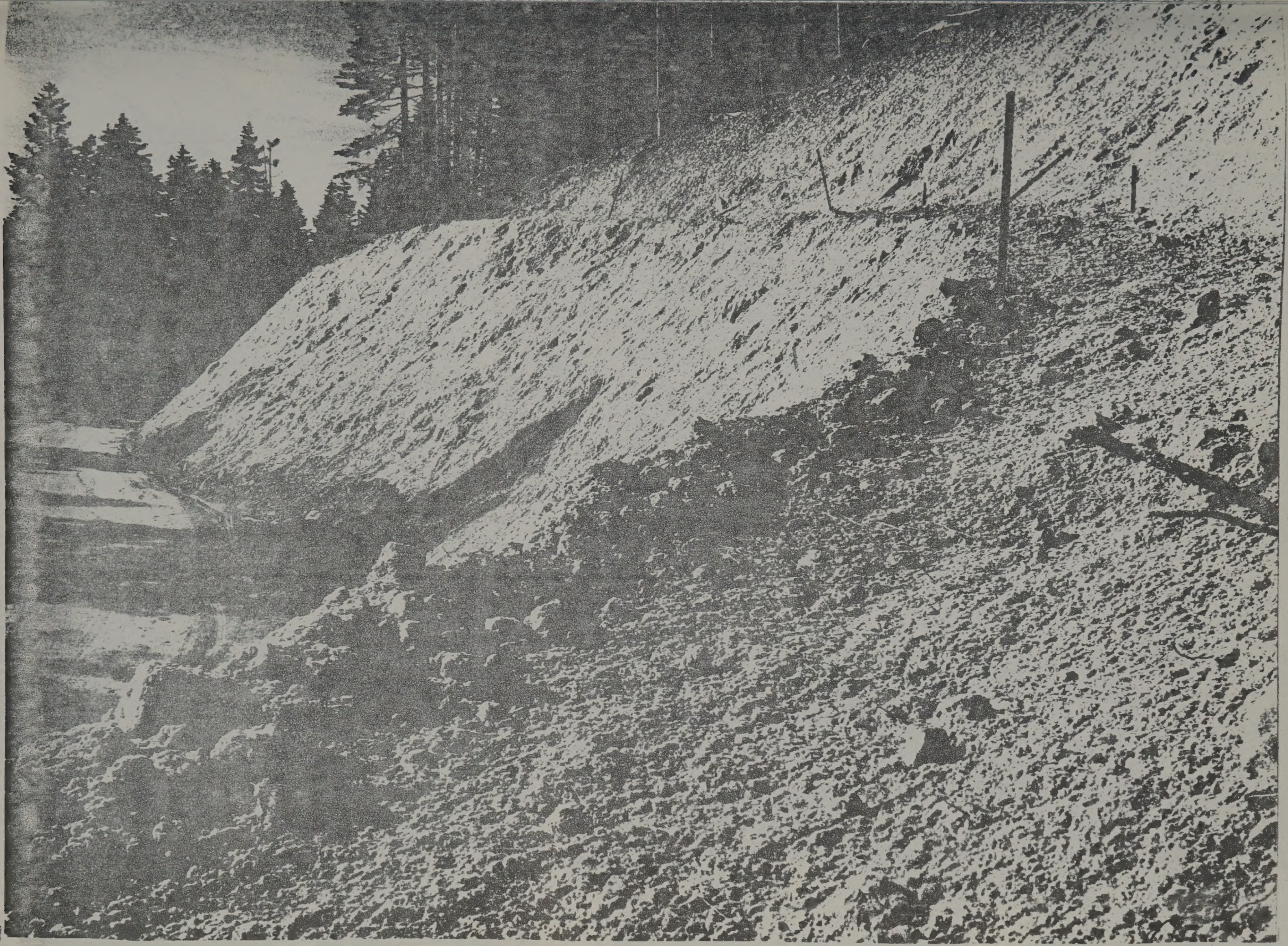


Photo 24. Steep roadcuts, left overwinter in this condition, are difficult to stabilize in this higher portion of the Incline Village area. December 7, 1969.

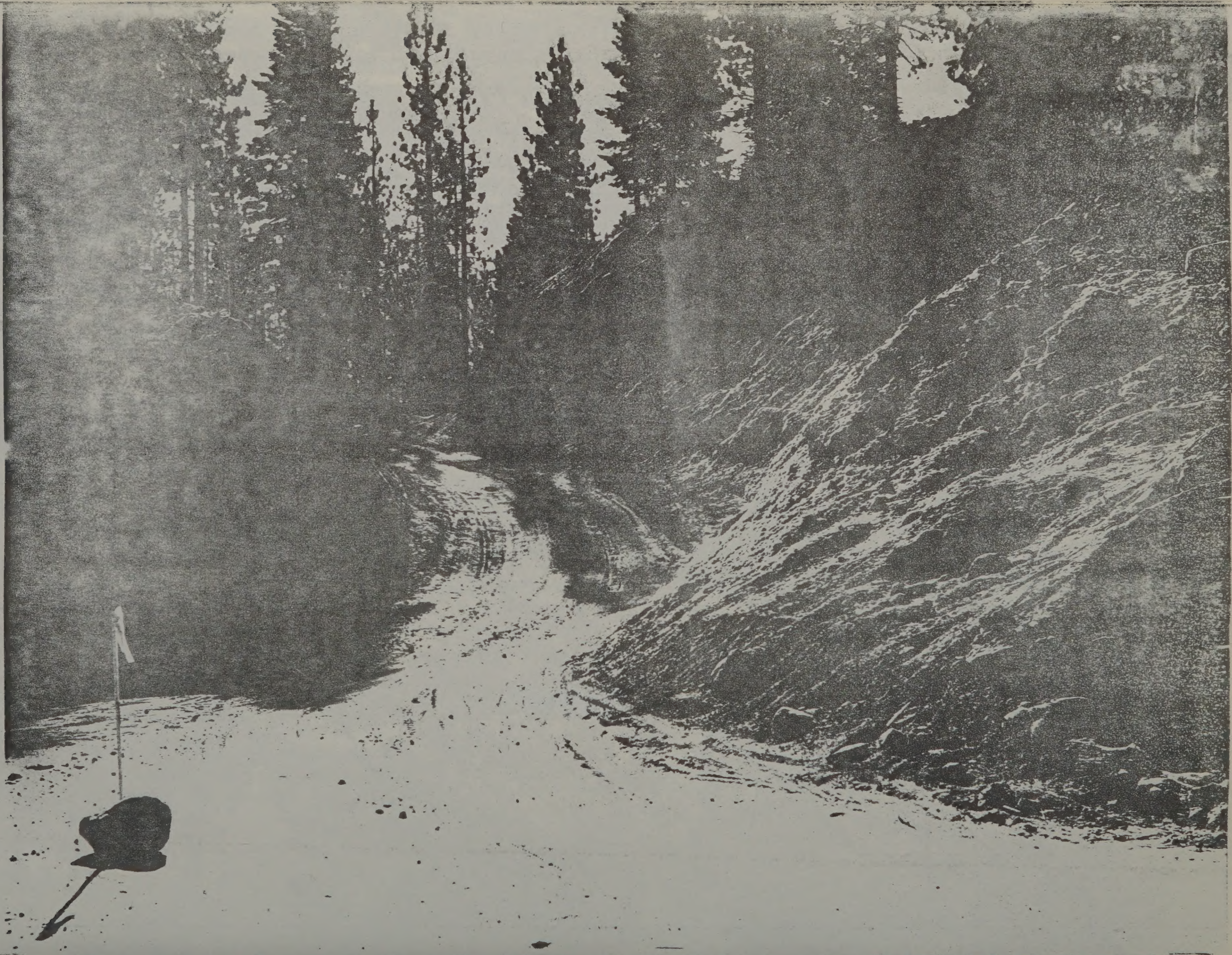
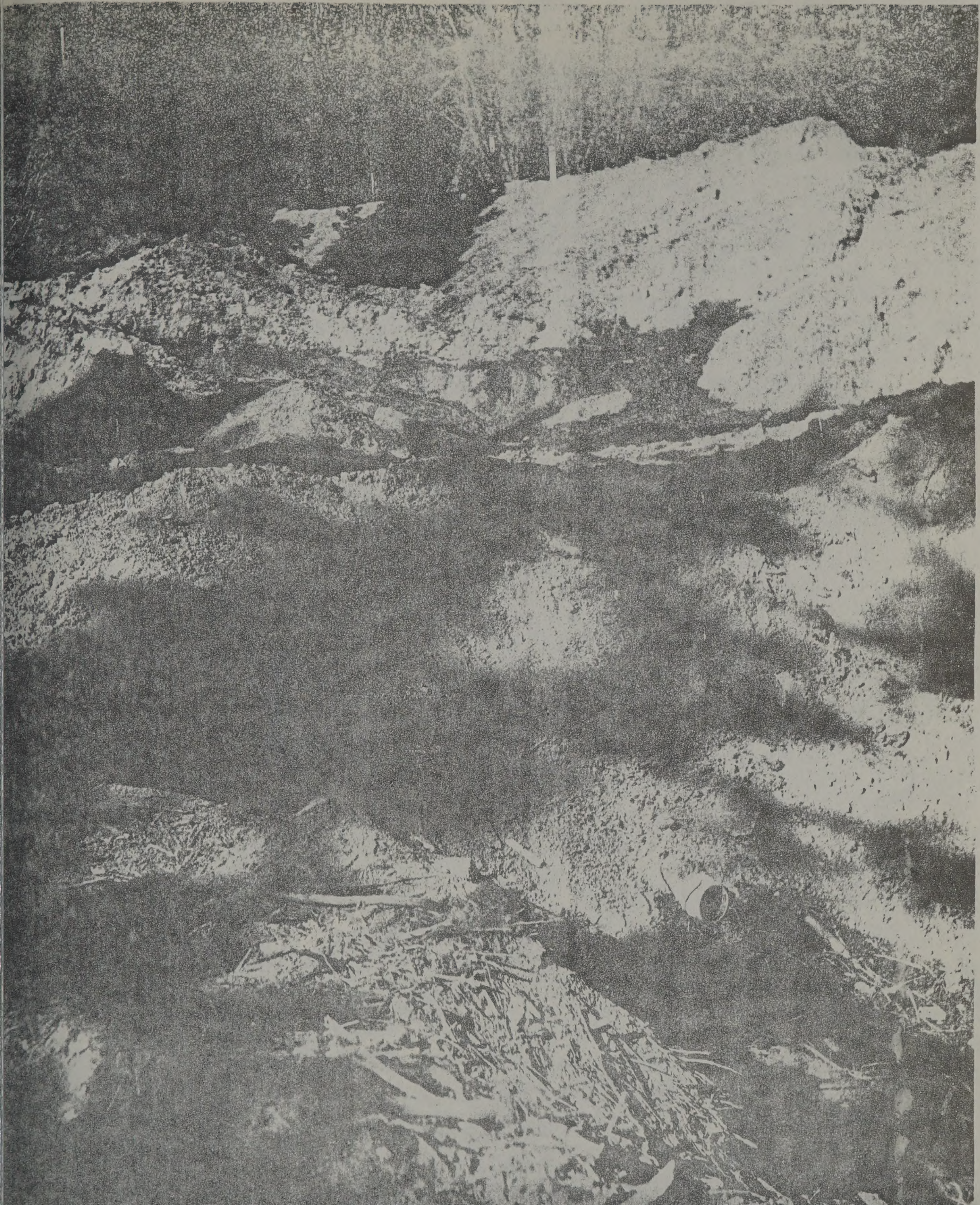


Photo 25. This road was cut through without regard to topography. Hydromulch on these slopes



hoto 26. A fill of top soil into a drainage area will erode, leach and create a sedimentation hazard for several years. Drainage provisions are inadequate. Incline Village, December 7, 1969.

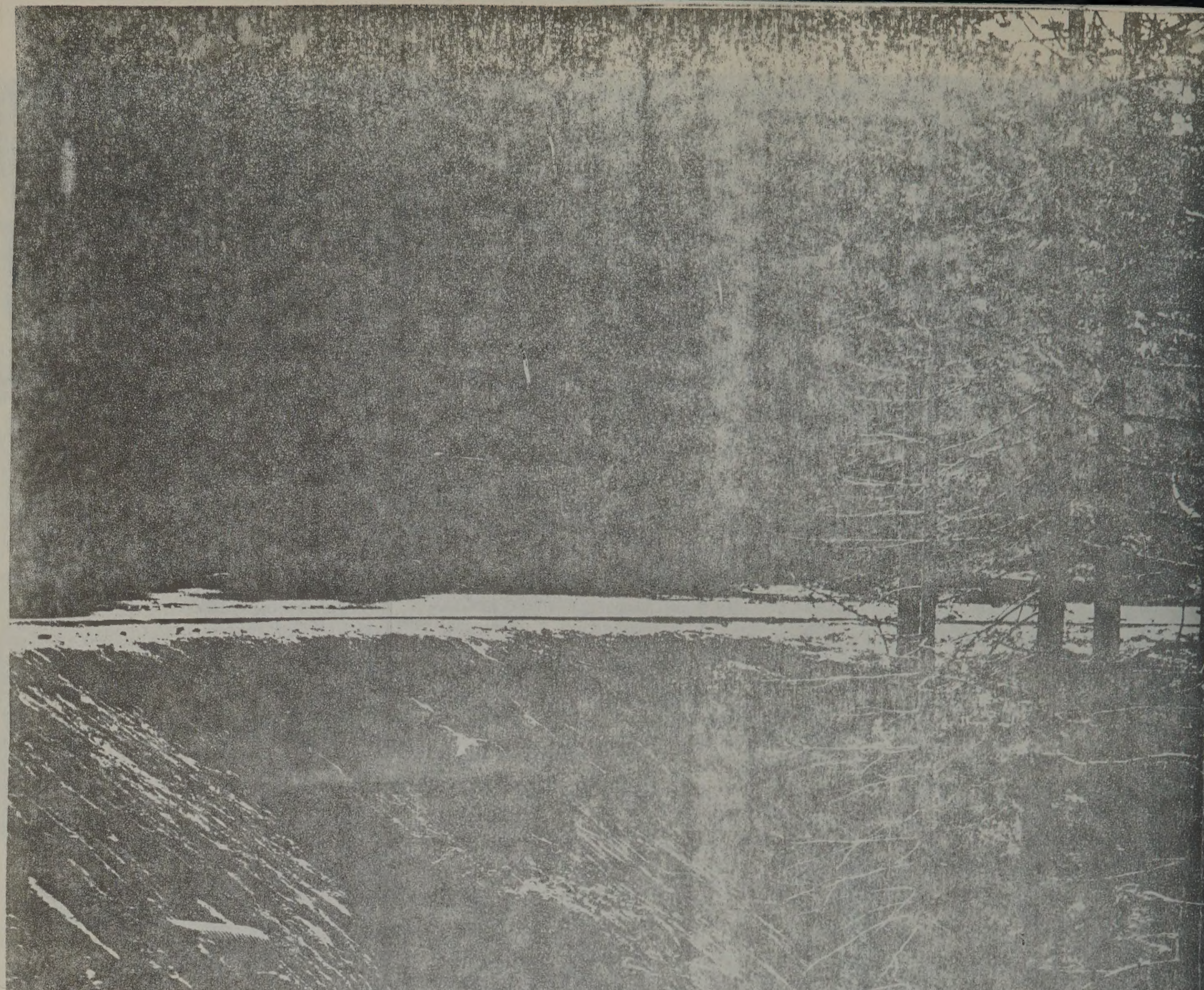


Photo 27. A stream entering a road construction emerges carrying sedimen and eroding the fill bank from the other side of the construction as shown in photo No. 37. Incline Village December 7, 196.

hoto 28. (See caption of photo No. 27)

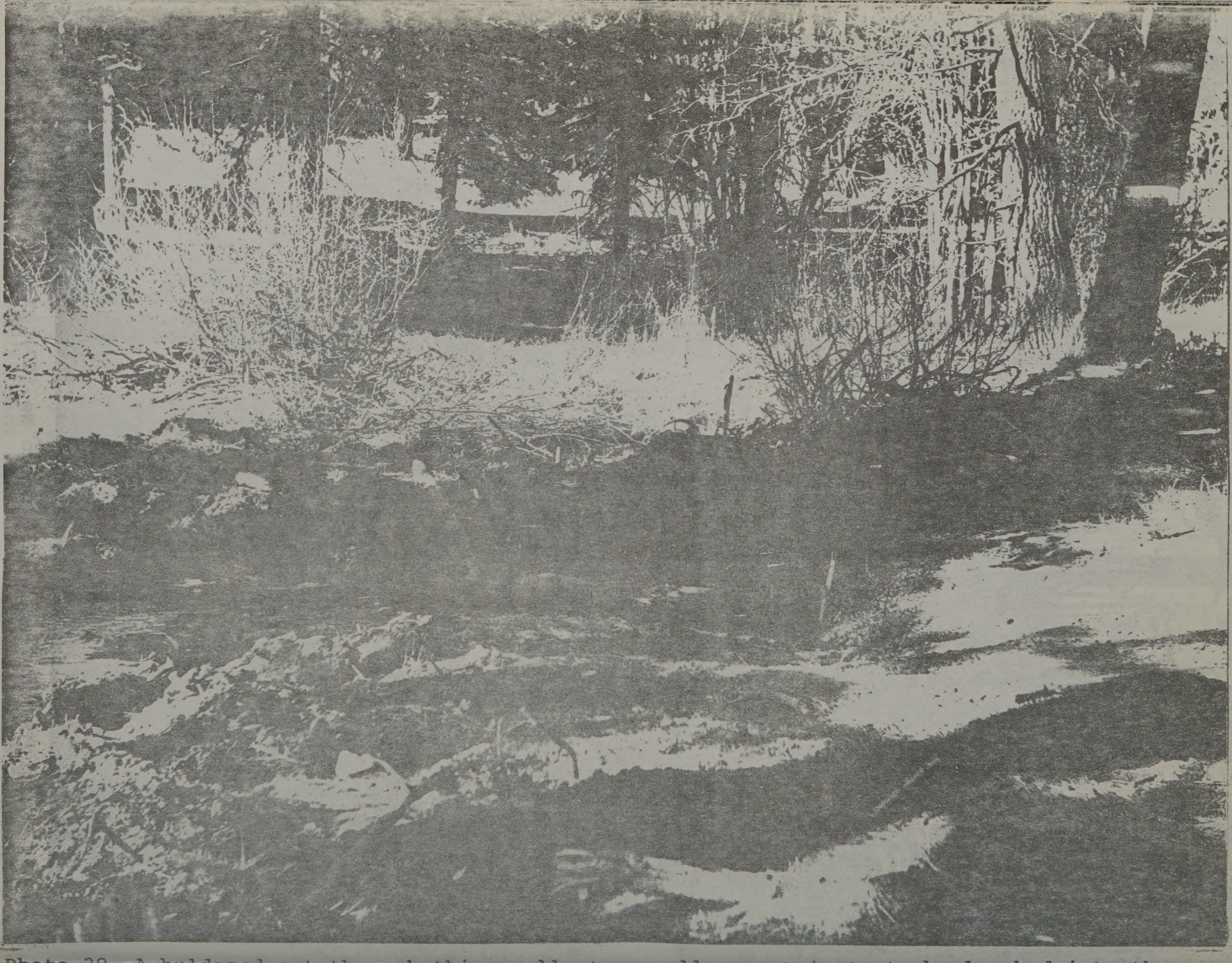
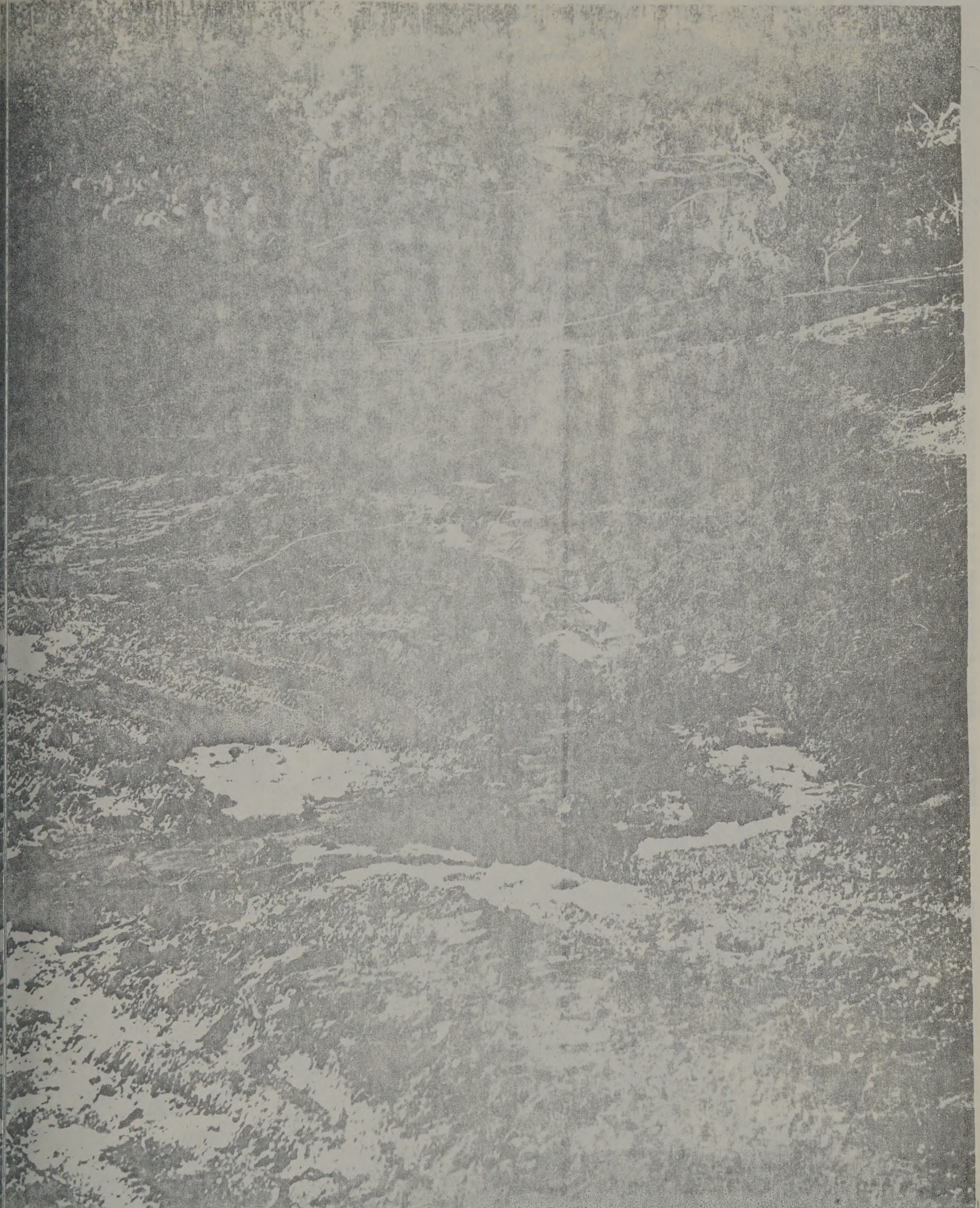
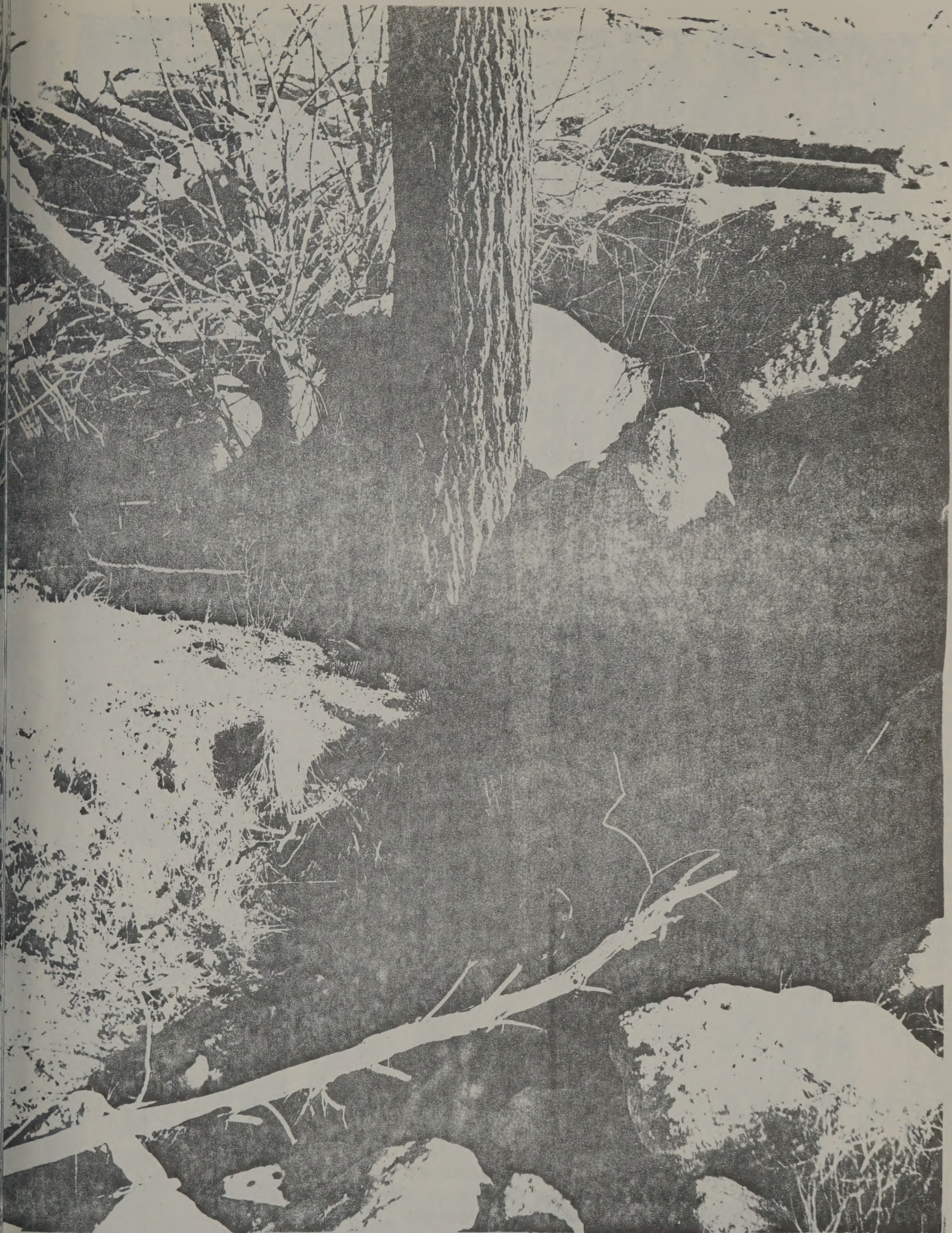


Photo 29. A buldozed cut through this small stream allows nutrients to be leached into the the stream. Incline Village. December 7, 1969.



oto 30. Stream disruption and piling of slash in channel create silting even at the lowest stream flow during early December after an extremely dry fall. Spring runoff will flush more sediment. December 7, 1969.

Photo 31. Close-up showing silty water and sand transport in same stream (see photo No. 30, caption), Incline Village, December 7, 1969



oto 32. Material filled into this small stream channel will eventually kill the trees and vegetation and increase flood damage. Incline Village, December 7, 1969.

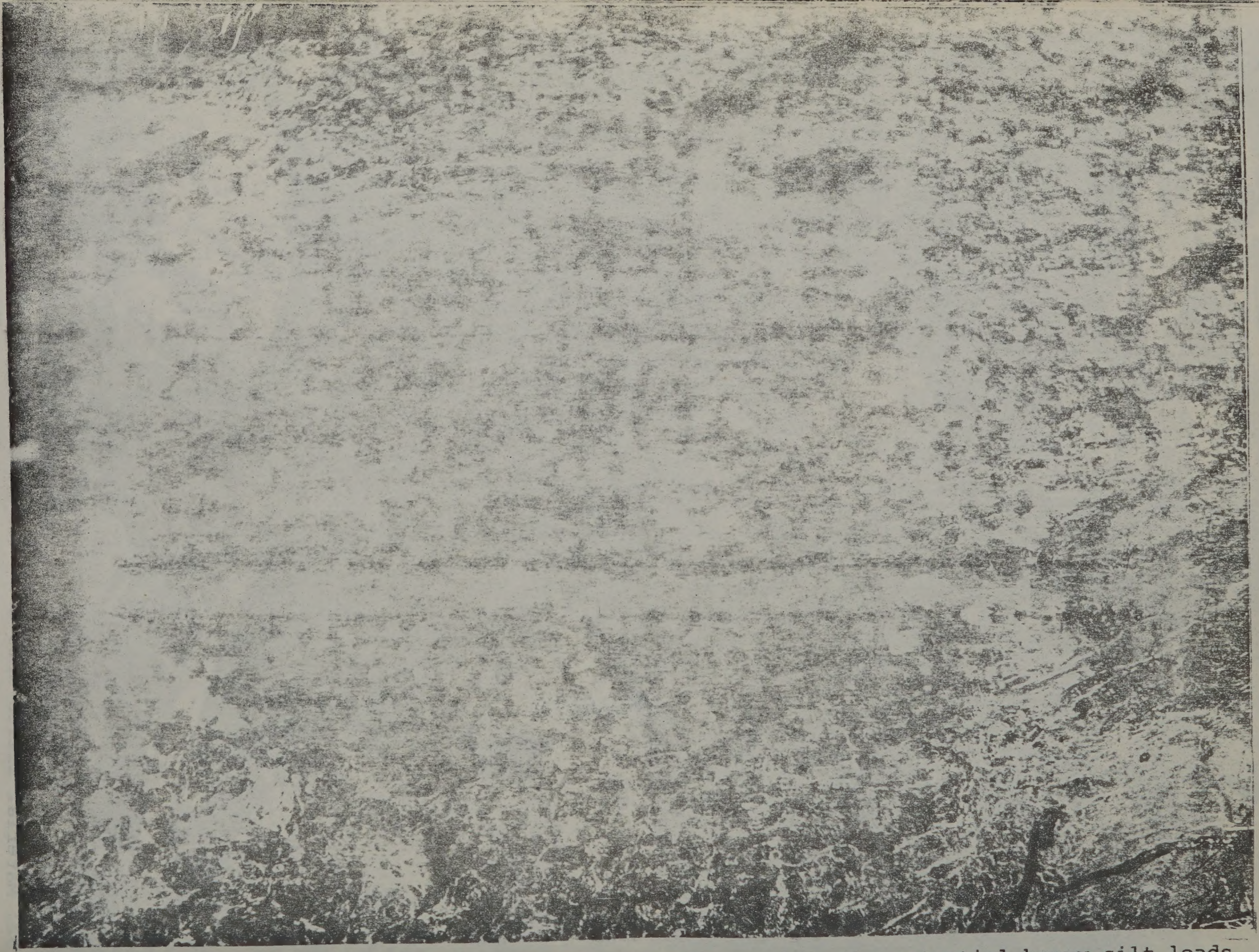


Photo 33. Salmon spawning in Incline Creek are endangered by the potential heavy silt loads of streams in this area. December 7, 1969.

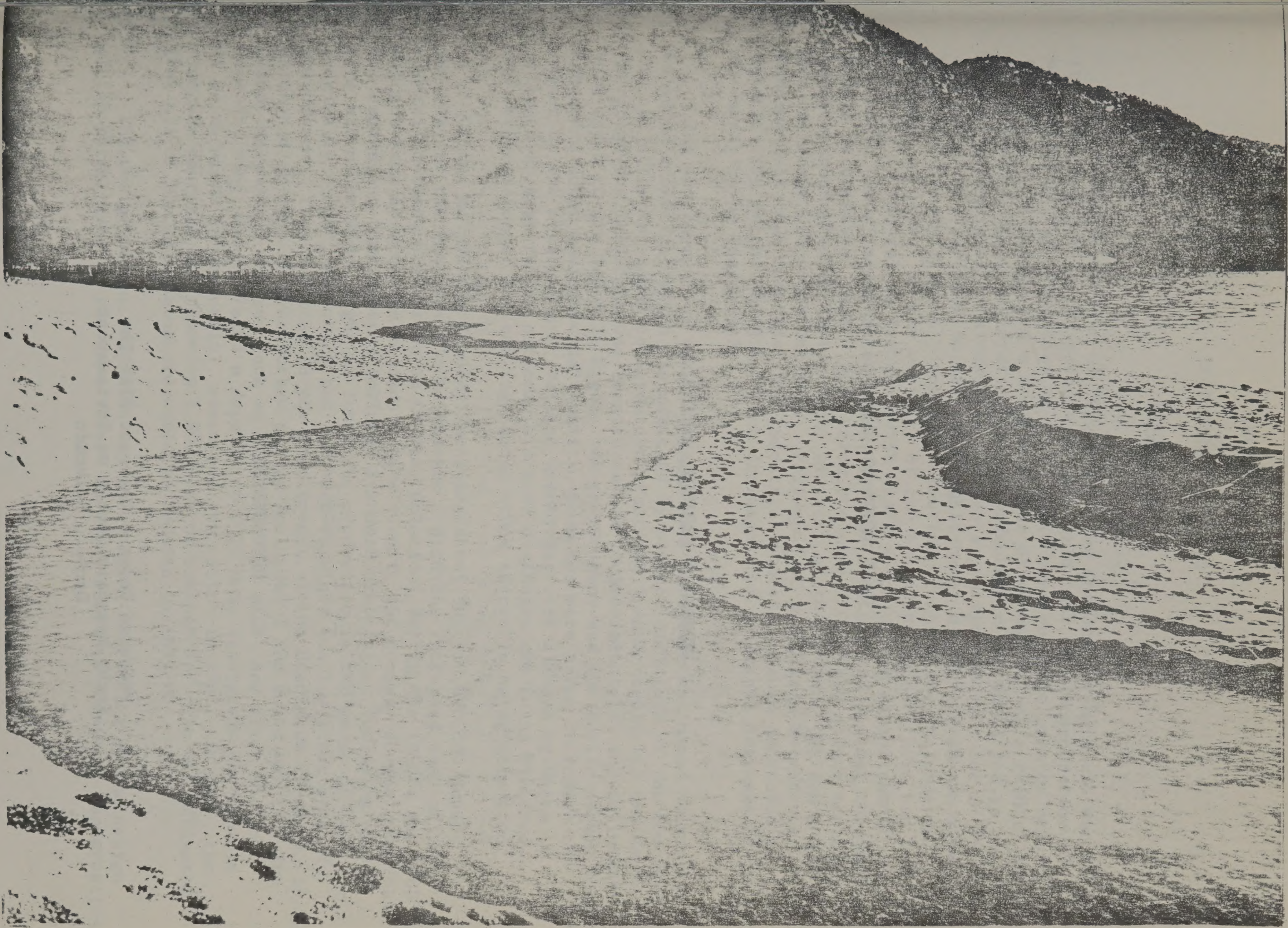


Photo 34. The mouth of Third Creek showing the large amount of sediment deposited here changing the course of the creek.

CASE STUDY NO. III

HENDERSON PROJECT, COLORADO

by

HUGO FERCHAU

Prepared Under a Contract With The
Rocky Mountain Center on Environment
Denver, Colorado

CHAPTER I

RECITATION OF FACTS

Historical

With the production of "Big Bertha" by Germany during World War I, it became evident to the nations of the world that the incorporation of molybdenum in the production of steel would make possible greater versatility in utilization and a greater number of products. As a result, the world saw increased exploration for molybdenum, in the field and in reviewing assays of ores taken from mines at earlier dates. One of the results of the exploration was the establishment of the molybdenum mine at Climax, Colorado (Fig. 1), and the formation of the Climax Molybdenum Company, in 1918. In the vicinity of the molybdenum mine, there had been activity in the valley for nearly 50 years prior to the establishment of the mine. Four incorporated towns, several smelters and several thousand people occupied the valley just below the mine. Gold and silver mining had been conducted actively in the vicinity of the present tailing ponds. Two railroads traversed the area. Personnel of the Climax Molybdenum Company feel that municipal and industrial wastes probably destroyed all aquatic life in the Ten Mile Creek drainage (the principal drainage of the area) by at least 1882.

The development of the molybdenum mine at Climax was based primarily on sound economics, which, as admitted by present officials of the Company, did not allow for sound conservation practices. As a result, in the early operation the landscape was treated rather indiscriminately, and pollutants were added to the Ten Mile Creek. As the Company and the public became more concerned about environmental quality, measures were taken to reduce the impact on the environment. Tailing discharges were diluted by being released at high runoff periods, old mine drainages are being diverted, and revegetation of the tailings among other things is being attempted.

Climax Molybdenum Company furnishes about 50% (60,000,000 pounds in 1968) of the Free World's molybdenum. With the increased uses of the mineral, maximum production at Climax, Colorado, during the 1950's and 1960's did not keep up with the demands. As a result, the Company sought new areas for expansion. Exploration followed standard procedures, including examining old mines which might no longer be productive in the grade of ore originally sought, but which had not been examined for low grade ores of molybdenum. This resulted in the development of the Urad Mine (Figs. 1, 3) which had originally been worked during World War I and World War II. The Climax Molybdenum Company took an option on the mine, and after diamond core drilling, demonstrated a deposit of 0.3% MoS_2 (low grade but capable of being mined economically), exercised the option in 1962. In 1967, the mine was operational, removing 5,000 tons of ore per day. It was estimated that all of the molybdenum ore would be removed by 1975.

The design of the Urad Mine was to a degree controlled by the design of the former mine at the same site. However, wherever possible, conservation

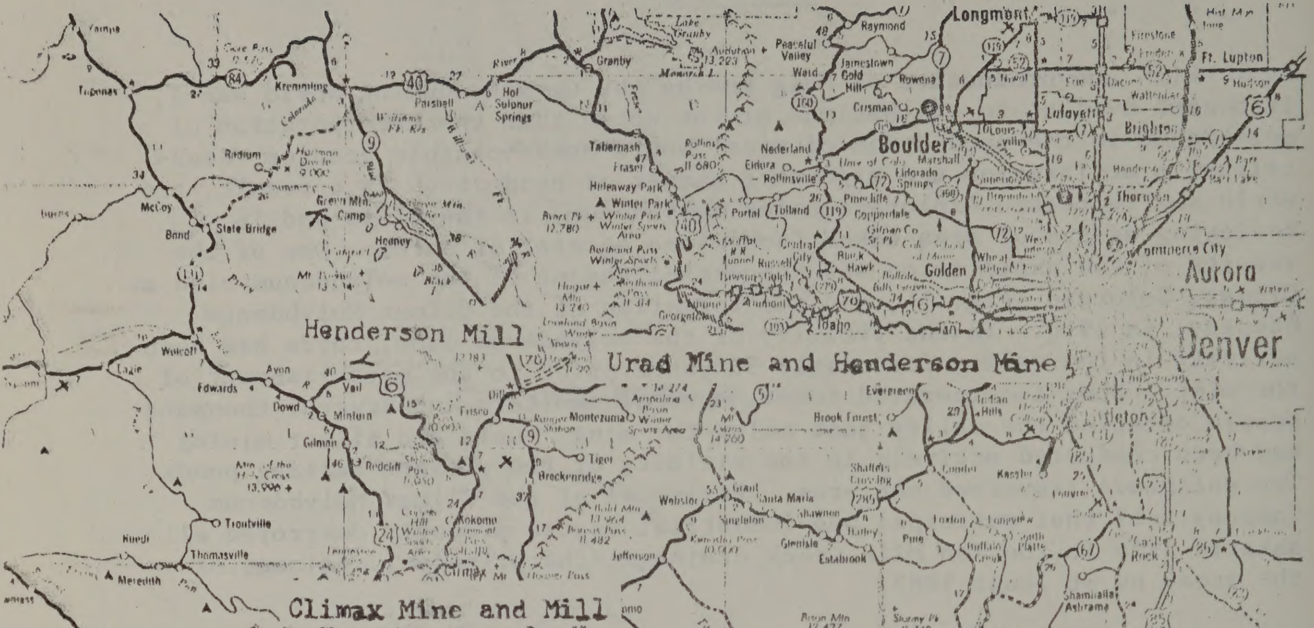


Fig. 1. General location of Climax mine and mill, Urad mine and mill and Henderson Project mine and mill.

techniques brought to light in the Climax operation were incorporated. Among them was the design of tailing ponds so that tailing bypassed the natural flow of Woods Creek and Ruby Creek; this technique relied on diversion of the natural flow, through pipes, under the tailing ponds. The water decanted from the tailing ponds accumulates in a reservoir and is then cycled back through the milling operation.

Exploration continued in the vicinity of the Urad Mine. In 1966, at 2,300 feet below the level of the Urad Mine, a molybdenum deposit was found, estimated to be large in size (303,000,000 tons) and also of a higher grade (0.49% MoS_2) than at either Climax or Urad. Among other things, the limitations associated with topographic and geographic features caused the company to approach the new deposit from the north side of the mountain in a different drainage (Figs. 2, 3). The new project was named the Henderson Project.

The Henderson Project entailed the normal considerations for any mining operation, such as the location of shafts, milling, tailing ponds, access roads, utilities, water supply and other aspects of mining logistics. The considerations were the same as those encountered in the establishment of the mine at Climax, Colorado, in 1918, except in one respect. The passage of time had given some of the executives of Climax Molybdenum Company a respect for natural mountain environment as well as an awareness of conservation and environmental impacts as they related to mining operations. In addition, the company, in its previous operations, had become conscious of the public's increased environmental awareness. Observing trends in federal and state legislation, the company could foresee that in developing a mine which was to open in 1975 and be operative more than 40 years, greater consideration had to be given to develop the mine that would not be subject to criticism by the public and that would not run afoul of future legislative controls.

In the early planning phases, company executives, as individuals and not officially, had the opportunity to meet with the representatives of the Colorado Open Space Foundation, an environmental service organization headquartered in Denver, Colorado. Further meetings resulted in a more formal structure entitled "Experiment in Ecology." The group involved representation from the Colorado Open Space Foundation (a lawyer, a chemist, an ecologist, a wilderness expert, a metallurgical engineer) and from the Climax Molybdenum Company (the assistant to the Vice-President, the division attorney, the project director, the director of environmental control). The emergence of this "unholy alliance" (as it might have been considered in the 1920's) resulted in further development planning from a conservation point of view tempered with economics. The ultimate direction of the Henderson Project was determined by Company planners with recommendations from the members of the "Experiment in Ecology." For this reason it is difficult to determine what measures were introduced for the purpose of fulfilling minimum standards to comply with public feeling and anticipated laws and what were included at the recommendation of the environment-oriented membership of the "Experiment in Ecology."

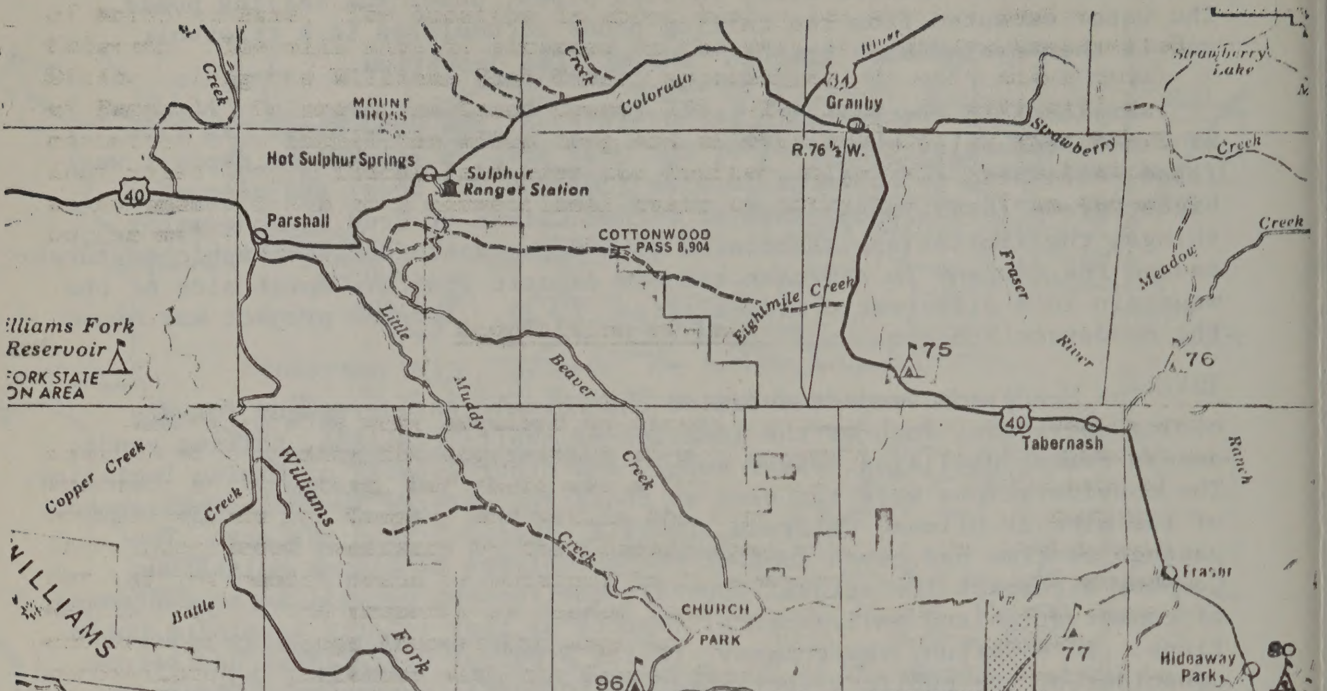


Fig. 2. Location of Urad mine and mill and Henderson mine and mill.

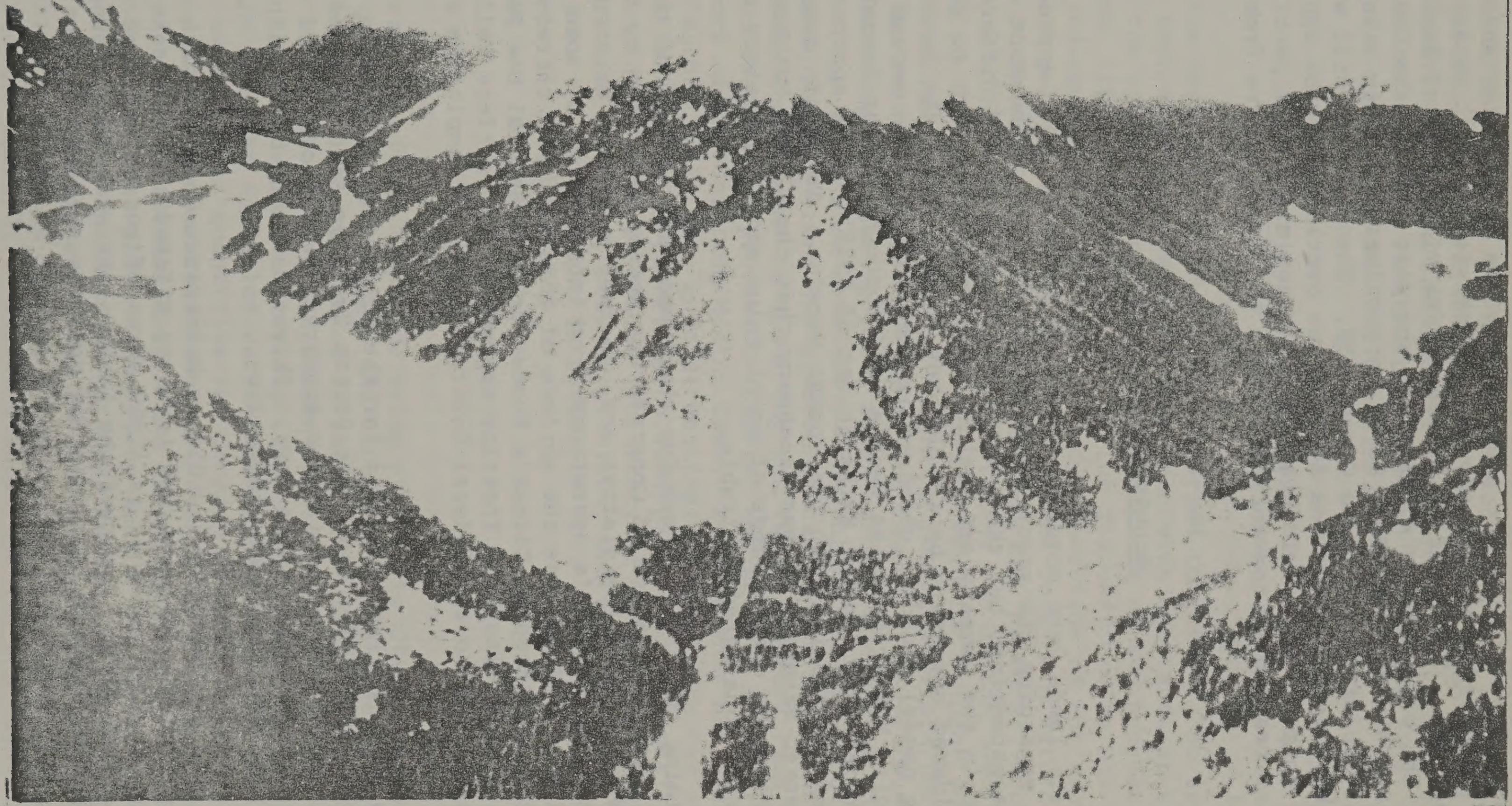


Fig. 3. Red Mountain with Urad development in the valley to the left and the Henderson mine site in the valley to the right. (Courtesy of Climax)

Location of the Henderson Project

Figures 1 and 2 show the general location of the mine and mill. The mine is located approximately four miles west of U.S. 40 at the foot of Berthoud Pass. The location is about nine miles west of Empire, Colorado. The mill site is situated on the west side of the Continental Divide, along the Williams Fork River, approximately twenty miles south of Parshall, Colorado, on Grand County 138. The mine and mill will be connected by a tunnel ten miles long and an overland portion approximately four miles long. Tracks laid over the fourteen miles will permit either an automated train or a conventional train to carry the ore from the mine to the mill.

Acquisition of Lands

Private lands were acquired by direct purchase. Two approaches were considered regarding the acquisition of public lands. The more conventional approach is patenting, but there was a legal question and difference of opinion within the Company and within the Forest Service as to whether the lands considered necessary by the Company (particularly the land required for tailing ponds) could be obtained in this manner. The second approach was to acquire the property as deeded land through regular Forest Service exchange proceedings (Forest Exchange Act of 1922). This approach necessitated negotiation with the Forest Service. To obtain desired lands from the Forest Service, it was necessary that the Climax Molybdenum Company have under option lands of equal value and of a quality that the Forest Service considered desirable.

Obtaining the right-of-way for the tunnel and control of the land above this tunnel by an act of Congress was deemed desirable by the Company. Without that legislative act, no real precedent existed which would protect the Company's operations from interference by some other party placing a claim across the surface of this land and thereby stopping Company operations despite Climax's Forest Service Special Use Permit or Department of Agriculture or Interior easement. The surface railroad right-of-way reverts back to the Federal Government at the completion of the operation.

The bulk of the land required for the mill site and tailing storage area has been applied for under the Forest Exchange Act. Some of the land in the vicinity of the mine site was acquired by the location of mining claims under the general mining laws. Thirteen mining claims (approximately 215 acres) were patented under these laws.

Some land purchased by the Climax Molybdenum Company which was not necessary for the mining operation is being offered to the Forest Service in the exchange. Much of this is 1,500 acres of recreation land along the Williams Fork River. Most of the land in the exchange offered by the Climax Molybdenum Company is recreation type (as suggested by the Forest

Service to be the most desirable for public ownership in the State of Colorado). The Company has selected a total of 8,960 acres within the project boundaries (within the Arapaho National Forest) for which it has offered the Forest Service 8,456 acres of privately-owned land in various National Forests throughout Colorado (in 21 parcels ranging in size from ten to 2,234 acres). All construction will be on private land, and no Federal permit or license will be required.

Disposition of Lands

With the exception of the tunnel referred to earlier, no specific plans have been made as to what will be done with the lands at the conclusion of the operation, nor what the conditions of the properties will be at that time. This point was raised during discussion with Don Stephens of Climax Molybdenum Company and Wally Lloyd, Supervisor of the Arapaho National Forest. Both parties feel that considering the long-term nature of the operation, it is difficult to predict what social, cultural, economic, and other factors will indicate the most beneficial use of the land at the termination of the operation. Discussion between the Company and the Forest Service has included plans for (1) returning the area within the National Forest to the Forest Service; (2) using the land for future land exchange; (3) rehabilitating all tailing ponds areas used in the mining and milling operations. The impression obtained by the author is that there is a legal question as to whether the government can impose conditions upon the Company, since the Company is acquiring the land as deeded land. There is a mined land restoration provision (enacted by the 1969 legislature) within the framework of the Colorado Mining Laws. Despite what has been stated above, the author feels some general meaningful agreements can be made (which will be elaborated later) which will prevent a potentially unhappy ending to what otherwise is a beautiful story of cooperation between state and federal agencies, conservationists, and big business, as exemplified by the "Experiment in Ecology."

Utilities

An operation of the magnitude being planned by Climax Molybdenum Company requires considerable gas and electricity. A major gas line over the Continental Divide was planned by the Western Slope Gas Company, a subsidiary of the Public Service Company of Colorado. When the Climax Molybdenum Company decided to develop its mining operation, it discovered the gas line would be installed very close to its operations; gas would be readily available in quantities the Company demanded. When the gas line was installed, cooperation between the Western Slope Gas Company, Forest Service and the Climax Molybdenum Company resulted in lines being laid in conjunction with planned roads, so that a minimum of forested lands were disturbed. The Arapaho National Forest provided staff officers and rangers to aid in the selection of routes. This was followed by several public meetings in Denver, at which the line was seriously contested. Once construction started, a liaison officer and two assistants were assigned to the project and worked in the field making suggestions as the pipe was installed. The Company retained an ecologist to oversee actual work, to assume minimal disturbance and to facilitate rehabilitation.

The mining operation requires a 115 Kv source of electricity. Several years before Climax Molybdenum Company put the Henderson Project into operation, a major transmission line had been installed by the Public Service Company south of the Henderson Project in the vicinity of Georgetown (Fig. 1). The power was used at the Urad Mine and was planned for the mining operations of the new project. However, transmission lines needed to be installed from the Georgetown source to the mine. When the original lines were installed, the public reacted to the unsightly nature of the towers and the amount of forest (trees and surface) which had been disturbed. Recalling this reaction, the advisors ("Experiment in Ecology") to the Henderson Project suggested a more aesthetically appealing design for the installation of the transmission lines. As a result, the utilities company worked very closely with the Arapaho National Forest Landscape Architect in the design and location of the "Henderson Line."

Selecting the shortest route for the transmission lines would have required crossing a 12,000 foot range. Therefore, a route was selected which would permit a gradient from Georgetown (8,512 feet) to the mine (10,400 feet). Difficulties were encountered at Georgetown because the town is included in the National Register of Historic Sites under the National Historic Preservation Act (Public Law 89-665). Arrangements were made with town officials to establish a route for the transmission lines, but the State Historical Society of Colorado objected. A Special Committee under the National Historic Preservation Act was appointed and the matter was resolved by mutually agreeing to modifications proposed by the Public Service Company of Colorado. The modifications involved the reduction in numbers of poles, the reduction in the size of the poles and the alteration of the general system of distribution within the community which would reduce the number of poles.

The route from Georgetown required transmission poles in "travel influence zones," which is contrary to the accepted concepts of the Forest Service. Since no alternative routes were available, the design of the lines accommodates the situation. Wooden-pole H-frames were used instead of metal towers, and the wood of poles and crossarms were stained a mottled green and brown, so that the poles blend with the landscape. The conductors (wires) on the line are of a non-specular type. In the manufacturing process, the usually shiny aluminum was dulled to avoid reflection of the sun's glare. In some instances, hardware used to support the lines on the poles was painted during the construction period, to blend with the environment. The forester from the Public Service Company of Colorado and the Landscape Architect from the Arapaho National Forest walked the route and made recommendations according to the conditions of each area. The right-of-way was constructed erratically to prevent the appearance of a slot through the forest. Width of the right-of-way varied from a minimum of 30 feet to a maximum of 75 feet. Trees less than ten feet high were not cut. Trees over ten feet were topped back to eight feet to encourage a spreading growth form. Large trees were felled. All timber and slash cut were removed completely to eliminate opportunity for disease propagation. The cut trees and slash were removed by horses to avoid breaking the ground surface unnecessarily. Helicopters were used for the construction of the lines and for transport of men and materials to eliminate need for access roads and surface disturbance. All landing areas and storage depots were located at sites which prevent disturbance. Figures 4 and 7, provided by the Public Service Company of Colorado, illustrate some of the techniques employed.

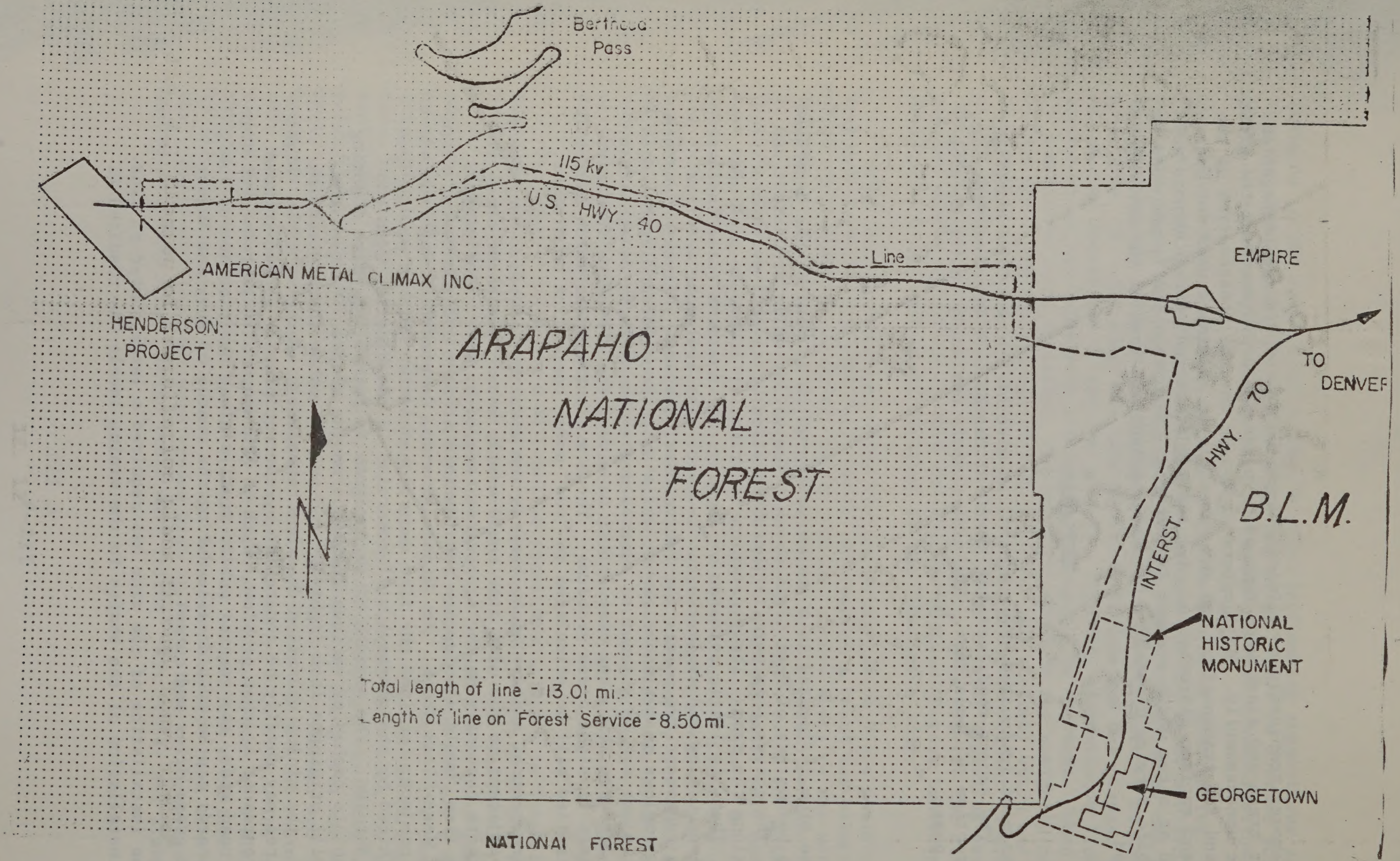
Mine Site

The mine is located about nine miles west of Empire, Colorado (Figs. 1, 3). The access road leaves U. S. 40 at the base of Berthoud Pass, in the direction of Jones Pass. The mine site is currently in the developmental phase.

The mine is located in a narrow valley which is part of the watershed for the headwaters of West Clear Creek. The valley walls are abrupt and sharp. The access road permits the observation of several avalanche areas along the road. The vegetation is primarily lodgepole pine and aspen. There is little evidence of logging; the dominant trees indicate extensive burning and avalanche in the past. The avalanche and fire hazards represent two points for future consideration. Climax Molybdenum Company employs an avalanche expert who also gathers meteorological data. Current plans are to attempt to control avalanche areas by revegetation, and in one case, by using excess fill to divert the avalanche from any area where it might cause problems. Those avalanche areas which cannot be controlled will be stimulated to "run" under controlled conditions.

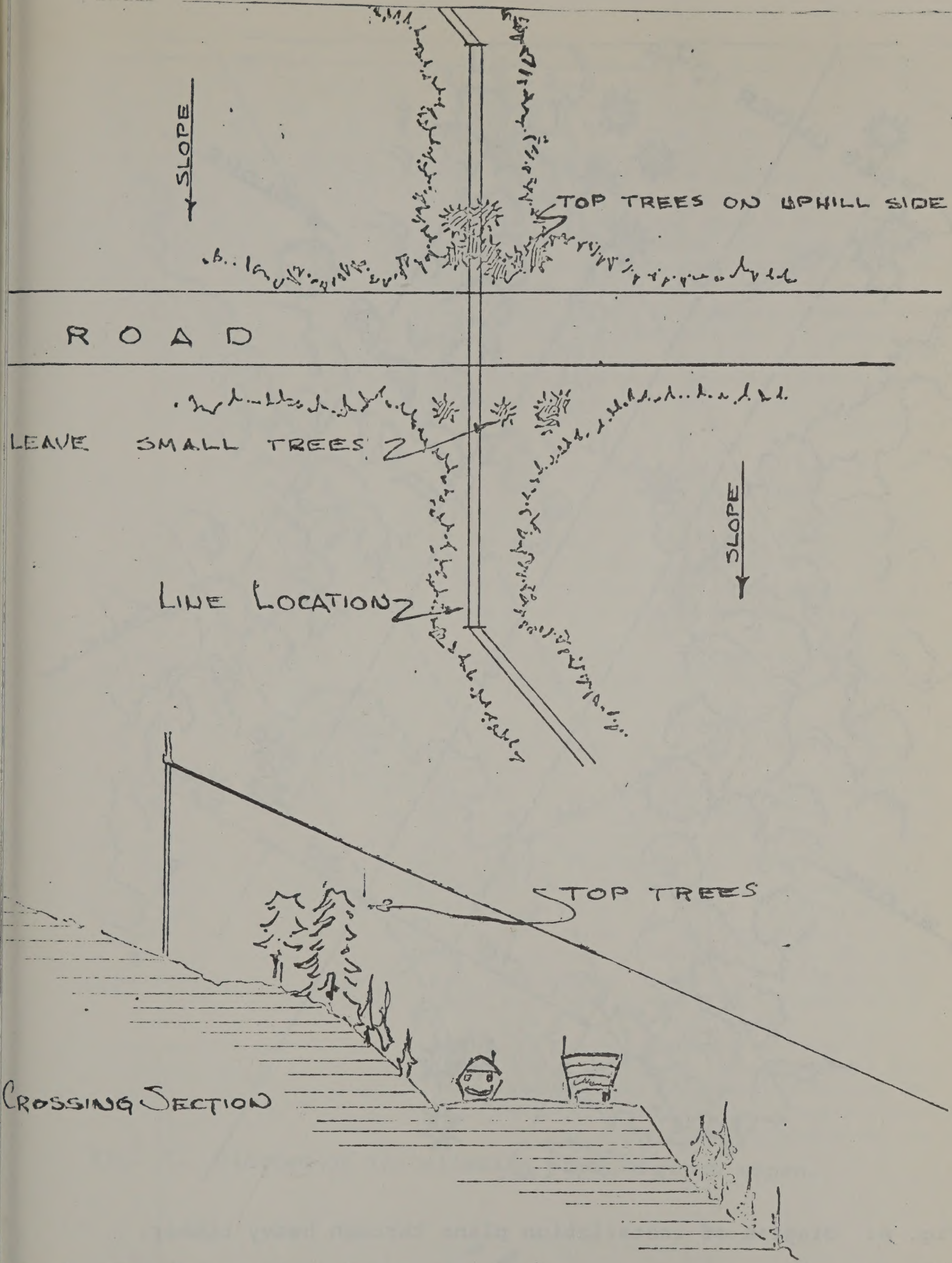
Fire control and avalanche hazards are directly related. Many steep slopes adjacent to the mine site could easily become avalanche areas if the forests currently on the slopes are removed by fire. The slopes, after a fire, would also create considerable erosion and subsequent siltation of West Clear Creek. Mr. Richard Huston, Construction Superintendent of the project, outlined the fire control procedures which a professional staff (hired by the company) will supervise in coordination with the Forest Service. The essence of the program is patrolling; fire fighting equipment is cached at various locations on the slopes. Most of the fires will originate from lightning and people; other than increasing traffic, the mining operation does not represent a source of fire. Lightning fires may readily be controlled by current plans. People-induced fires represent another problem. With an abundance of dry grass available at the road side, the general public traffic along the mine access road, fire hazards can be considerable during the months of July and August (as the grass dries and cures).

The installation of the mine has required a large number of land cuts; installation of the shafts to the mining levels has resulted in



Total length of line - 13.01 mi.
Length of line on Forest Service - 8.50 mi.

Fig. . Georgetown-Henderson 115 kv electrical transmission line.



ig. 5. Upper area shows irregular nature of the lines. Lower shows line with respect to vegetation.

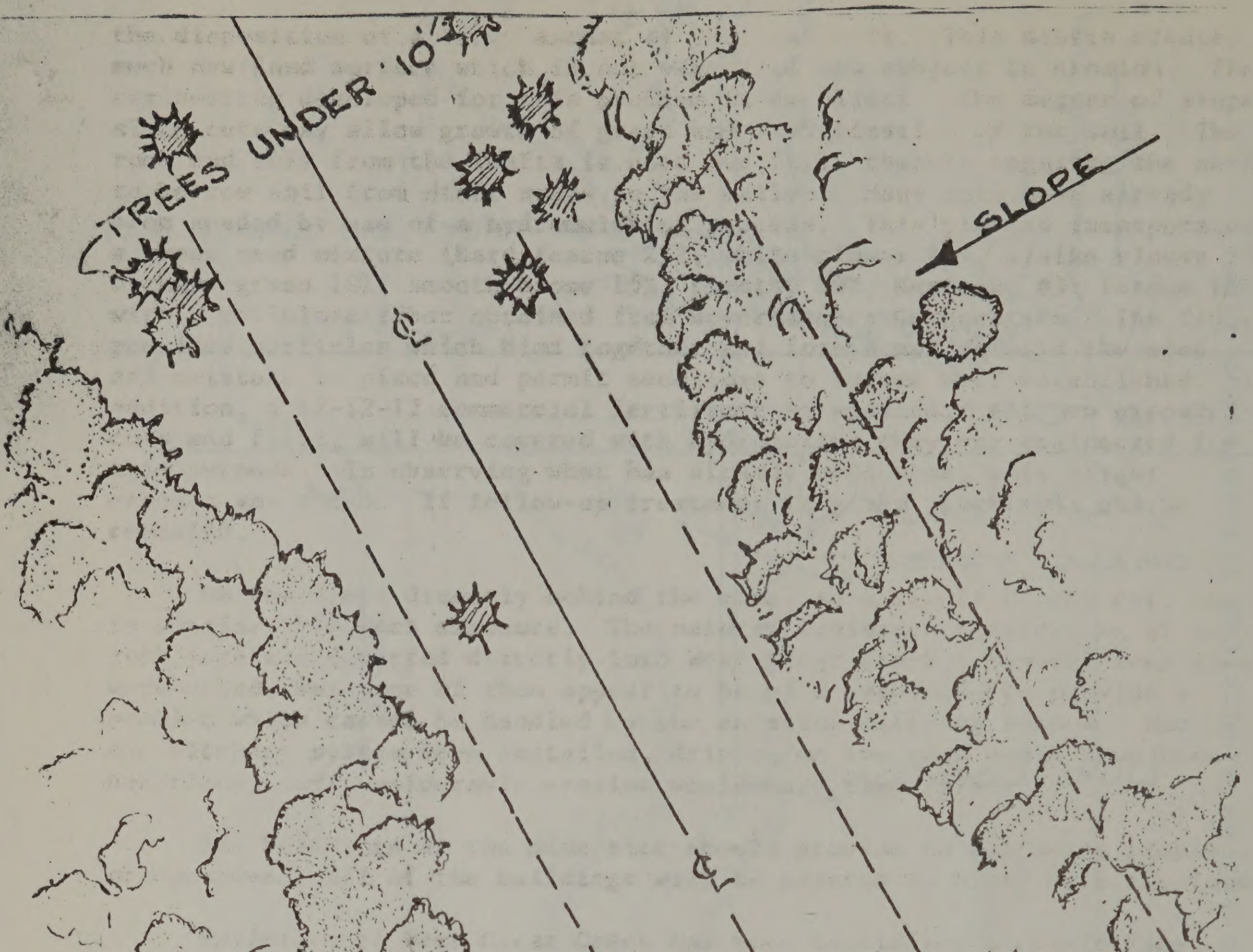


Fig. 6. Diagram of installation plans through heavy timber.

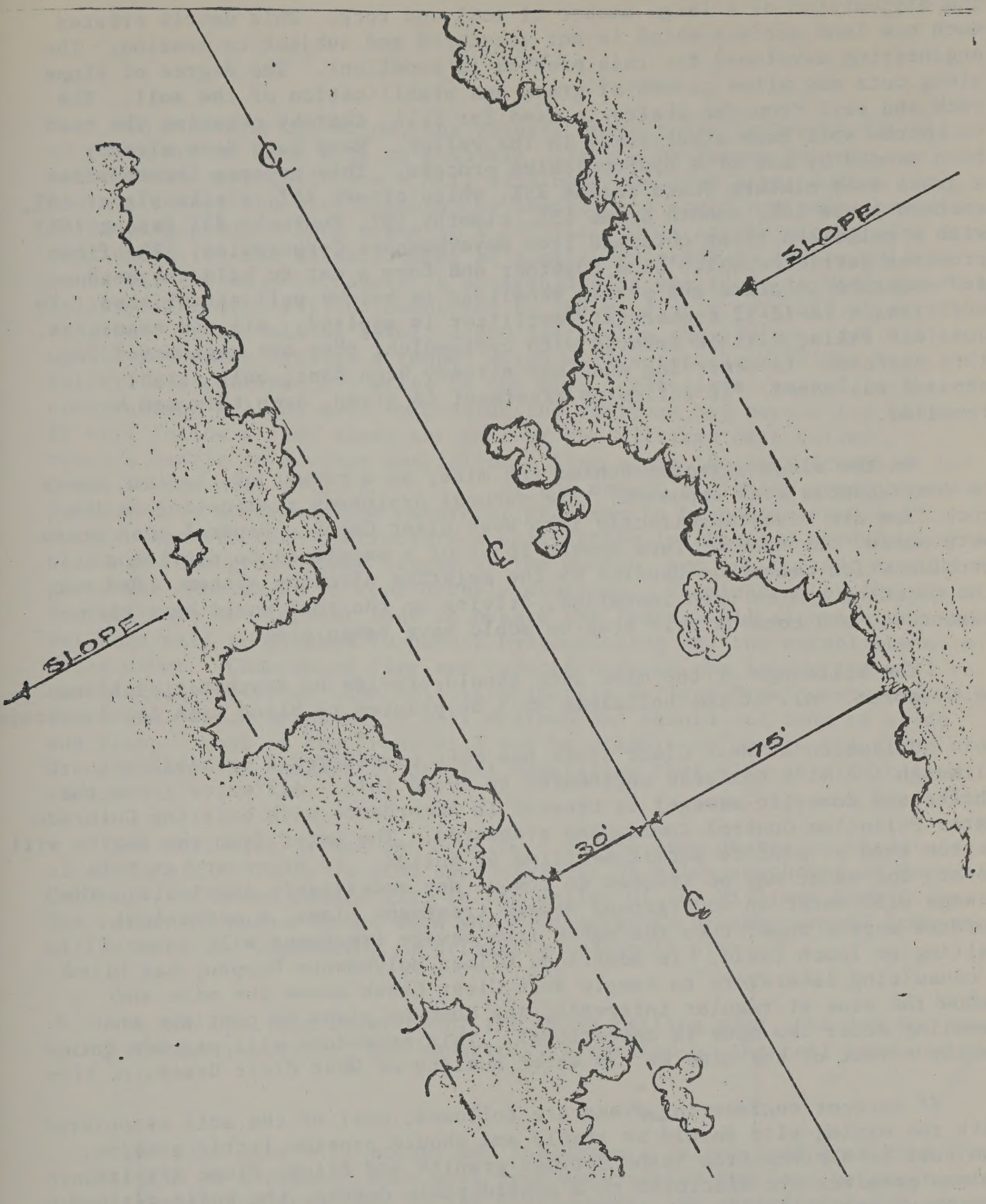


Fig. 7. Diagram of installation plans through aspen.

the disposition of a large amount of soil and rock. This debris creates much new land surface which is not vegetated and subject to erosion. The engineering developed for this problem is excellent. The degree of slope along cuts may allow growth of grass and stabilization of the soil. The rock and soil from the shafts is used for fill, thereby negating the need to borrow soil from other areas in the valley. Many cuts have already been seeded by use of a hydromulching process. This process incorporates a grass seed mixture (hard fescue 25%, white clover 15%, alsike clover 15%, orchard grass 10%, smooth brome 15%, timothy 10%, Kentucky #31 fescue 10%) with a cellulose fiber obtained from Weyerhaeuser Corporation. The fiber provides particles which bind together and form a mat to hold the seed and moisture in place and permit seedlings to become well established. In addition, a 12-12-12 commercial fertilizer is applied. All new exposures, cuts and fills, will be covered with hydromulch; they are engineered for this purpose. In observing what has already been done, only slight erosion was noted. If follow-up treatment is given, even this can be remedied.

On the slope directly behind the mine, as a result of the cut, there is considerable rock exposure. The natural drainages terminating at the rock face are diverted directly into West Clear Creek. Several seep areas were noted, but none of them appear to be of a magnitude to provide a problem which cannot be handled by the existing ditching system. Had not the ditching system been installed, driving on the road would have been hazardous, and considerable erosion would have taken place.

The buildings at the mine site should provide no aesthetic problems or eyesores. All of the buildings will be painted to blend with the landscape.

Pollution of West Clear Creek has been considered a possibility, although the mine has been engineered to avoid this. All water (from the shafts and domestic sewage) is treated in accordance with existing Colorado Water Pollution Control Commission standards. The water from the shafts will be run into a pond to permit settling of solids. If necessary at this point, the water may be treated to remove any undesirable chemicals. The sewage will enter an underground sewage treatment plant, a mechanical aerated septic tank; then the water from sewage treatment will enter a tailing or leach field. In addition, Climax Molybdenum Company has hired a consulting laboratory to sample West Clear Creek above the mine and below the mine at regular intervals; the Company plans to continue the sampling after the mine is operational. This procedure will provide data on the effect of the mine on the water quality of West Clear Creek.

If current engineering plans are followed, most of the soil associated with the mining site should be stable and should provide little problem. The soil is derived from Idaho Springs granite and Silver Plume granite. Unless granites are fractured to a considerable degree, the soils derived are characteristically stable.

Mill Site

In a mining operation, the natural thing to do is locate the mill as close to the mine site as possible. In the Henderson Project, an attempt was made to locate a mill site near the mine site; such a site was not considered wise because the environment could not take the impact of tailing ponds. Land areas in a 25-mile radius of the mining site were considered for the establishment of a mill, in order to locate tailing ponds off any major streams. A desirable site was found in Williams Fork Valley. The mill will be connected to the mine by a railroad which will originate at the mining level, 2,900 feet below the surface, and will run uphill ten miles through a tunnel which will enter the Williams Fork Valley, and continue 4.5 miles to the mill. Materials removed in the tunnel construction will be used to provide the railroad bed across the valley. It will follow a rise along the wall of the Williams Fork Valley, cross a saddle in a ridge and follow a line along the East Branch of Ute Creek to the mill (Fig 8). At the moment a pioneer grade has been bulldozed to determine the nature of problems to be encountered and to furnish construction contractors specification information needed prior to bidding. The grade looks ragged at the moment, and its current condition gives the impression of considerable problems. Examination of the plans for ultimate development tend to negate the fears. All slopes along the railroad will be pitched to permit hydromulching and the establishment of grass cover. Chances of fire are reduced because the locomotive will be electrically powered. The soil is primarily derived from Cuesta Dipslope Sandstone, which means it is well drained and should not tend to slide and slump. Most of the grade will not be visible to people traveling along Grand County 138 because of natural vegetation that will shield it from view.

The mill site is not yet developed to the same degree as the mining site (Fig. 8). It is located approximately 25 miles southeast of Parshall, Colorado, on Grand County 138, in the valley of the Williams Fork River. The valley is rather broad with sharp topographic breaks removed from the mill site. The vegetation is primarily lodgepole pine.

Figure 8 shows the specific location of the first tailing pond, the dam for the water storage reservoir, the reservoir, a portion of the rail line and the mill site.

The mill site will occupy and influence a larger land area than the mine site. As a result, much more land acquisition and land negotiation was necessary for this part of the development. An estimated 9,000 acres will be involved with the mill site, settling ponds, reservoir, tailing ponds, railroad and roads.

The operation of the mill will consist of treating the ore brought in by rail with water from the water storage reservoir. The reservoir will be made up of water pumped from the Williams Fork River. It is

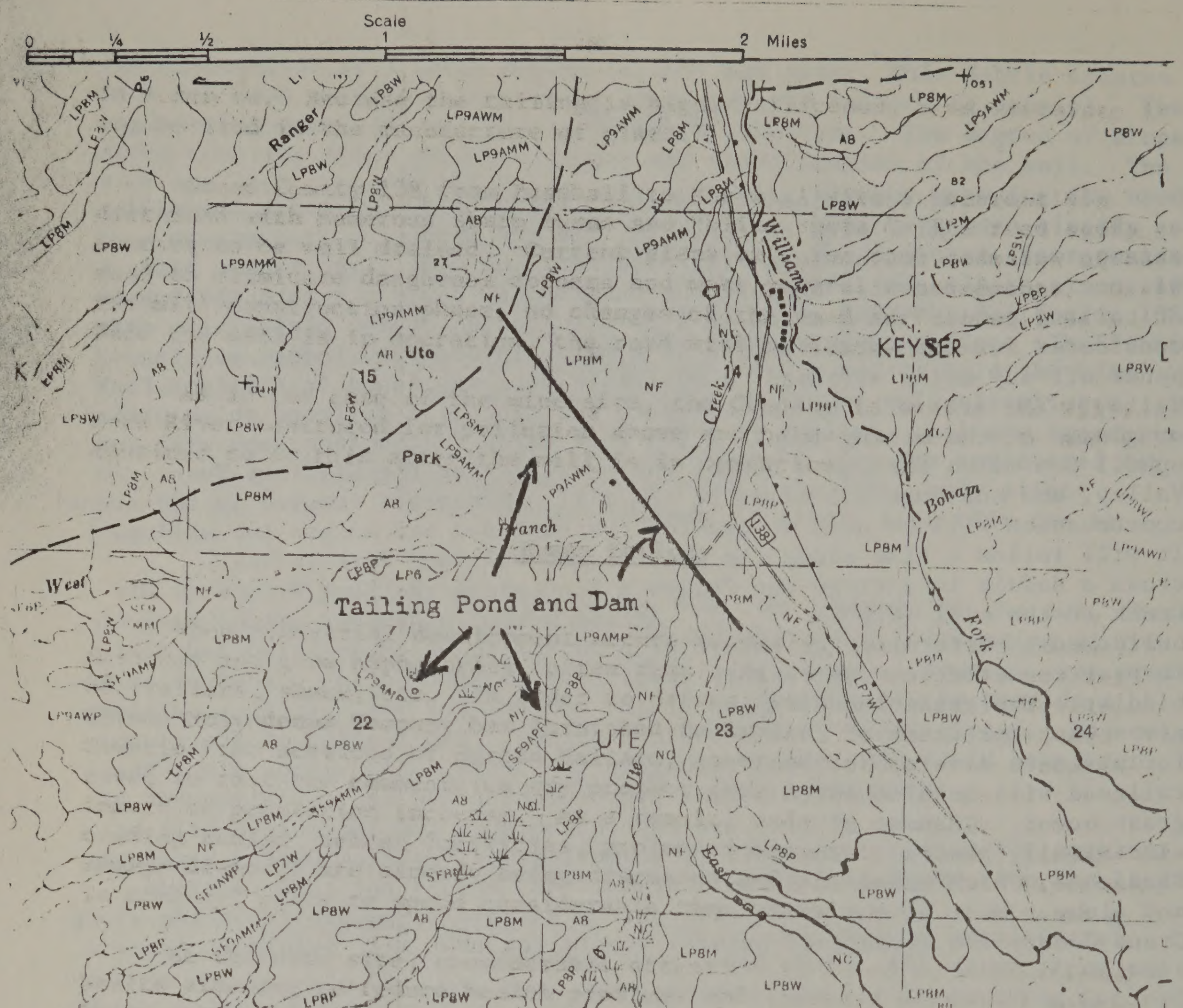


Fig. 8. Portion of Forest Service Map R-2 T2S-R78W 6th P.M. Location of Henderson Project mill, tailing pond and dam, water storage dam and reservoir.

estimated that 3,000 acre-feet per year will be pumped from the River. The Bureau of Sport Fisheries has recommended that a minimum flow of 20 second-feet, or the natural flow of the stream, whichever is less, be maintained downstream. Tailing will be piped through use of gravity to the tailing pond where water which drains off will be pumped back to the water storage reservoir and reused. The water will be operating in a closed system; none of the water used for ore processing will be permitted to enter the Williams Fork River. Some replenishment will be needed because of evaporation and because some water will remain with the tailings. Because of the recycling process, the water storage reservoir will be increasingly mineralized, and therefore, presumably, more saline. As a result the reservoir will not be managed for fish or recreation. It is anticipated the reservoir water will need to be treated if the water gets to the point where it reduces ore production effectiveness by one percent. Treatment will consist of precipitating out the minerals to form a sludge to be deposited with the tailing. The reservoir will be a self-contained unit with no outflow into any natural body of water. Climax Molybdenum Company tests of the soils beneath the proposed reservoir indicate no possibility of leakage from the bottom of the reservoir.

The location and establishment of the tailing ponds was given considerable attention. Tailing ponds are a necessary evil of mining; they represent a primary source of pollution, extreme unsightliness and considerable potential effect on vegetation. As shown in Figure 8, the tailing ponds will be located in a flat parklike area with little forest development, but will be shielded from the public eye in large part by the screening of forests and additional planting. As indicated earlier, the water from the tailing will be pumped back to the water storage reservoir to be reused rather than being lost to the River. To the southwest of the tailing ponds lie the Williams Fork Mountains. During a summer cloudburst or during a period of rapid runoff in spring, the tailing could easily be flooded and carried into the Williams Fork River. To avoid this possibility, a system of ditches and conduits has been engineered to assure that all the natural waters from the slope will be diverted around the tailing ponds and into the River. Therefore, the tailing ponds should be self-contained units and have no opportunity to contaminate the River or the water table.

As in the case of the mine site, all cuts made in the topography and all fills will be seeded to grass using the hydromulching process.

Climax Molybdenum Company is currently doing research (contracted by Colorado State University) at Climax, Colorado, on revegetation of tailing. Some progress has been made and presumably the results found at Climax will be incorporated into the tailing management at the new site. Difficulties are encountered in this research because of the unusual substrate (the tailing) and the severe climate of the environment of the particular tailing ponds. Initial vegetation will likely be grasses that ultimately may be used for grazing, either by domesticated animals or game animals. Despite the amount of tailing produced in mining operations, little research has been done to develop commercial uses of tailing. Research has demonstrated that tailing is too fine for road construction and use in concrete. Because the tailing is highly siliceous, some speculate it may be used in the manufacture of glass.

Grand County 138 from Parshall to the mill site is currently a dirt road with numerous sharp turns and "blind spots." The road surface appears to be well drained. Current plans call for some redesign of the road to eliminate dangerous corners and make general improvements. During the mill construction phase, no changes of the road surface will be made. Once the mill is in operation, the road will be black-topped.

As in the case of the mine site, the Company is having the Williams Fork River monitored for pollution above and below the mill site and will continue to do this after the mill is in operation.

Human Ecology

When industrial development occurs suddenly, quite often communities mushroom and grow haphazardly, often resulting in an unsightly scattering of trailers, shack, etc. In order to prevent such undesirable development, Climax Molybdenum Company has furnished to Empire, Parshall and Grand Counties the services of Harold Ballard, governmental relations representative, so that the communities may project growth and be prepared for the impact of population increase. As a result, orderly community growth including zoning, school facilities, projected community income, garbage and sewage disposal are already being discussed and planned. The "Experiment in Ecology" plans to spend considerable time on this sort of planned growth.

At the mine site, considerable attention is given to occupational health planning to reduce health problems and increase personnel morale. Among other things, such planning calls for a comprehensive ventilation system. Also, the entrance to the mine shaft leads directly from the parking lot into dressing rooms where odors and general discomfort will be minimized. From the dressing rooms the miners will go into the shaft at the 100 foot level. When leaving the mine shaft, the miners will have an opportunity to get dressed and be in street clothes when they enter the outside environment.

Multi-Use Concept

When the Climax Molybdenum Company begins operation of the Henderson Project, it will hold 8,960 acres for which it has made exchanges under the Forest Exchange Act. In addition to what it has purchased from private owners, it will also have acquired 271 acres by patenting. For the exchanges, 8,456 acres of mostly recreation lands will be added to the public domain throughout Colorado.

According to the earlier reports by the Bureau of Sport Fisheries and Wildlife, the project would "eliminate" 9,000 acres of deer and elk summer range, including 4,000 acres of hunting lands. This estimate is generally supported by the Colorado Division of Game, Fish and Parks. However, the Company estimates that the mine-mill-railroad-tailing pond complex will initially occupy approximately 1,500 acres. Within 30-40 years, a second tailing pond could occupy another 1,500 acres. Present planning of the "Experiment in Ecology" contemplates containing all tailings in the initial site on Ute Creek which ultimately would occupy 2,000 acres of range and hunting lands.

The reason for these discrepancies in land-use estimates, the author believes, is not that the wildlife agencies desire to exaggerate the impact while the Company wishes to minimize it. The BSFW makes its impact estimates for 100 years and considers all possible expansion of human activity in an area which has been partly devoted to ranching for over 50 years. Also, the unusual efforts being made by Climax to accommodate game range, hunting and fishing, and otherwise minimize the Henderson impact have probably not been considered by the estimators.

The Bureau of Sport Fisheries and Wildlife further estimates that fishing will be "affected" on 16 miles of the Williams Fork River and 17 miles of Williams Fork tributaries. According to the Company, there will be a "minimal and temporary" effect on about two miles of West Clear Creek near the mine site, occasioned mainly by increased siltation from land cuts until these are stabilized by vegetation already being hydromulched. The only "effect" of the mining operation on the Williams Fork River (a popular fishing spot for Company employees) will be to make accessible to the general public 1,500 acres along the Williams Fork previously held by private owners and closed to the public. While approximately 3,000 acre-feet/year will be diverted from the Williams Fork to the mill, a minimum flow of 15-20 second-feet will be maintained on the River, higher than present low flow. Whether or not fishing on the Williams Fork will be "improved" as a result is conjectural.

Approximately eight and a half miles on the three branches of Ute Creek and three miles on Mule Creek, tributaries to the Williams Fork, will be destroyed by tailings deposition. Earlier plans to use four miles of Lost Creek have now been abandoned. The Mule Creek section may not be affected at all, depending on whether it will be necessary to develop another tailing pond at that location in 30-40 years.

It should also be pointed out that the tailing ponds are being designed for total "recycling" of waste water and elimination of seepage. Thus even during floods, downstream portions of these tributaries should not be affected at all.

Perhaps another reason for the discrepancies in the estimated mileages of fishing stream affected is that government agencies are using 1933 USGS quadrangle maps, while the company estimates are from 1967 aerial surveys. These surveys are now available to the government agencies.

Big game in the project area include elk, mule deer, black bear and mountain lion. Upland game species in the area include blue grouse, ptarmigan and snowshoe hare. Waterfowl, muskrat, beaver, mink, skunk, coyote, bobcats, marten and fox are found in the project area.

Small game and waterfowl hunting is of minor importance in the project area. However, hunting for deer and elk is heavy. The upper Williams Fork River Valley is important spring, summer and fall range for deer and elk. The animals winter at lower elevations near the Colorado River.

If the railroad is fenced, hunter access to some areas may be hampered. However, game movement should not be hampered extensively because most of the migration pattern parallels the railroad and because trestles will be used, instead of landfill.

For many years, much of the private land in the Williams Fork Valley has been closed to hunting. Climax Molybdenum Company, upon purchase of these lands, opened the area to hunting. The first year resulted in hunters indiscriminately driving over the property and destroying some ranch lands. The second year, although there were instances when hunters expressed their displeasures, the lands were closed to vehicles, but hunters were permitted to hunt on the land. This policy is expected to be followed in the future.

Some of the purchased land, originally grazing land, will ultimately be used as a tailing pond. This is particularly true of Skylark Ranch. The ranch has been leased and will continue to be used for cattle grazing until it is needed (estimated to be 30-40 years from now).

Several sites within the exchange area are designated for potential campsites or picnic areas. However, the land which the Forest Service has gained should provide sites of equal or better quality than what will be available on land owned by the Climax Molybdenum Company. If pressure should develop in the future, there are a number of locations in the Williams Fork River Valley which could be developed and perhaps be administered by the Forest Service.

No plans have been made to manage the forests, although the matter has been discussed and Company officials have indicated some kind of forest management program will be initiated. Forest conservation was attempted in the course of road construction, when salable timbers were cut into appropriate lengths, sawmill operators consulted and contracts signed. For some reason, few of the logs were picked up. The financial gain was negative, as far as the Company is concerned, but they hope to continue to find ways to develop a sound forest management program. The potential is present. The vegetation is primarily lodgepole pine and aspen, although in the far distant future it will change to spruce-fir. Thinning of the lodgepole pine will encourage more rapid growth of the trees which remain.

Climax Molybdenum Company is currently contemplating an ecological inventory of all of its lands so it may have an accurate assessment for management purposes of all of its properties.

CHAPTER II

ENVIRONMENTAL IMPACT

There is no question that an operation of the magnitude projected for the Henderson Project will have an impact on the environment. However, "conservation" by definition suggests that man make the best use of an environment. It does not prescribe preservation of all environments, although in some cases preservation is undoubtedly the course which should be followed. If mining is considered a necessary practice, it must take place somewhere; it must take place where minerals are located.

In the case of the Henderson Project, it does not appear to the author that sites selected are those which must be preserved. Furthermore, through careful planning and coordination between industry, federal agencies and the "Experiment in Ecology," the impacts on the environment have been minimized. Specifically, aesthetics were considered by blending buildings and other ordinarily conspicuous structures such as transmission towers with the surrounding habitat. Also such potential eyesores as tailing ponds and the railroad have been minimized by use of vegetation for shielding and rehabilitation purposes. Attempts have been made to avoid water pollution by engineering systems that will either cause natural waters to by-pass sources of pollutants or which prevent pollutants from becoming associated with natural bodies of water. Monitoring of the waters by an independent laboratory prior to initiation of the project and plans to continue the monitoring will provide data about the effects of the industry on the water supply. Attempts to insure environmental quality are demonstrated by industry and Forest Service efforts to utilize existing or projected breaks in the forest for the installation of major gas lines and to install transmission lines in a manner least damaging to the habitat. The use of hydromulching for stabilization of land cuts (thereby reducing erosion) is commendable. Such a practice should be encouraged or required of other agencies, such as the Forest Service and State Highway Department.

Although not directly associated with public lands, but having the potential of considerable environmental impact, is the question of community planning. Rather than letting the human community develop in a disorderly manner, the Climax Molybdenum Company has provided consultation services to local governments so that orderly growth and planned growth may be experienced.

The decision to abandon the idea of establishing a mill site in close proximity to the mine (as is normally done) and instead to construct the mill with accompanying tailing ponds in the Williams Fork River Valley, has resulted in lightening the environmental impact; the mine area could not have accommodated the tailing ponds without destroying a considerable amount of habitat adjacent to major highways and endangering natural waters and the constituents of an abrupt topography.

The Forest Service and other agencies place considerable value on the recreational uses of the lands in the general vicinity of the Henderson

Project. Consequently, the appraisal made by the Bureau of Sport Fisheries and Wildlife that 5,000 acres of wildlife habitat will be removed by the tailing ponds alone must be considered an environmental impact. This impact on the wildlife will eventually disappear as revegetation of the ponds proceeds. The loss is partly equalized by the addition of 8,456 acres of recreational land to the public domain, including some lands which previously had not been open to public recreational use. Furthermore, the opening of Company lands for hunting again opens some land to hunters which previously had not been available.

Installation of the railroad and fencing of the railroad may alter some grazing patterns of big game. However, use of trestles instead of landfills should minimize the problem.

One mile of fishing along West Clear Creek and 17 miles of fishing on tributaries of Williams Fork River will be eliminated. The Bureau of Sport Fisheries and Wildlife has estimated moderate fishing on West Clear Creek and only light fishing on Williams Fork River tributaries.

A primitive jeep road exists from the mine to the vicinity of the top of Jones Pass. Consideration was given to continue the road to the floor of the Williams Fork River Valley and thereby considerably shorten the distance between the mine and the mill. The thought of road extension was abandoned to preserve the wilderness quality of the area.

CHAPTER III

PROBLEM ORIGINS

As far as this author can determine on the basis of field observations, discussion with representatives of the Climax Molybdenum Company, Public Service Company of Colorado, Arapaho National Forest, Colorado Division of Game, Fish and Parks, and the Colorado Open Space Foundation, the Henderson Project represents a situation which is not a problem, but rather an example of how problems may be avoided.

Many laws and regulations were utilized in formulating the Henderson Project plans for development. Among them are: the general mining laws (Mining Law of 1872), public land laws involving Forest Exchange, Right-of-Way, Use Permits, under the Isolated Tract Act, and a Special Act of Congress for tunnel development. In some cases, surface resources continue to be managed by the Forest Service under Public Law 167. The Bureau of Sport Fisheries and Wildlife provided information and recommendations under the authority of the Fish and Wildlife Coordination Act. The National Historic Preservation Act was taken into consideration in the construction of transmission lines. Guidelines established by the Colorado Water Pollution Control Commission were utilized in the design of tailing ponds. Numerous regulation of the Forest Service were taken into consideration.

Mr. Stanley Dempsey, Division Attorney of Climax Molybdenum Company, states, "After reviewing in my own mind the procedures that we followed in complying with each of the laws, it is my conclusion that in most cases the statutes and their administration were a positive factor in our environmental program, and in no case were they a negative factor." However, he indicated that the long delays associated with acquiring public lands make it difficult for a developer to begin any planning, including planning for minimizing environmental impact. He feels the chief cause of delay is a lack of funds and manpower in the land managing agencies to handle required surveys, appraisals, and mineral or other field examination.

Despite the model conditions of the Henderson Project, the author feels there are areas which require future consideration. Tailing is one of the major problems in mining and represents a major source of environmental impact. In the Henderson Project, tailing accounts for the loss of thousands of acres of wildlife habitat. Legislation should be encouraged to determine how tailing may be used in other commercial processes rather than have it left to accumulate. Associated with tailing is the problem a company faces because today's laws seem to prevent patenting lands for future use as tailing ponds. This handicap means that land may not be available when and where a planned tailing pond is needed. As a result, a company will have to forego its operations. The laws instrumental for Climax Molybdenum Company operations involved land exchange, rather than land patents.

During the time when facts were being accumulated for this case study, it was difficult to determine what measures were being taken in the voluntary interest of conservation and which measures were in response to existing laws. The general impression received is that much of what is being done is voluntary as a result of a company which happens to be environmentally aware. As the project goes to completion, if the Company were to have a change of heart, existing law would not have the strength to effect some of the current environmental practices. As an example, Climax Molybdenum Company is not required to manage its properties with regard to wildlife and forest resources. The Bureau of Sport Fisheries and Wildlife has the authority to make recommendations but not to implement or enforce them. Although there are recent Colorado laws governing the condition of a mine upon cessation of operation, there appear to be no federal laws.

CHAPTER IV

ENVIRONMENTAL CONSIDERATIONS AND ALTERNATIVES

Considerations

Throughout research for this case study, one characteristic was consistently apparent, namely the willingness of a large corporation to seek advice and consultation from outside groups and a willingness to incorporate the outside thinking into the overall plan.

The personnel of the Arapaho National Forest were instrumental in providing the Company with information and interpretation of various

Forest Service policies and regulations, as well as providing advice in areas with which they are familiar. Specifically, the Forest Service was involved with the design of the transmission lines and gas lines, road construction, land exchange, fire and avalanche control and management programs.

The Colorado Division of Game, Fish and Parks and the Bureau of Sport Fisheries and Wildlife provided information and recommendation regarding how the land might best be managed to minimize disruption of fish and wildlife, particularly in the Williams Fork River Valley. In addition, Game, Fish and Parks assists in developing policies regulating hunting and fishing activities.

The Public Service Company of Colorado made recommendations on providing electrical service with minimal environmental impact and, in turn, accepted recommendations from the Forest Service. The Western Slope Gas Company cooperated with the Forest Service in protecting the natural habitat from installation of gas lines.

Certainly some groups have been omitted from this discussion. However, with equal certainty, it may be stated that superimposed over the entire cooperative effort is the "Experiment in Ecology," a group which left its impression on all facets of the project.

Alternatives

Because, first of all, the Henderson Project is not yet completed, and much information must still be gleaned from plans, and, secondly, because the Henderson Project is giving more ecological consideration than similar projects, it is difficult to find alternatives to this apparently unique, cooperative endeavor.

One point bears mention. Hydromulching is an excellent process for preventing erosion on land cuts by encouraging grass to establish quickly and, thus, hold the soil. However, one characteristic of grass should be considered. In the dry months of the year (July and August) the grass cures and in an unusually dry year is receptive to fire. Therefore, more consideration should be given to fire control, or perhaps people control, in areas where considerable hydromulching has been carried out.

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CASE STUDY NO. IV

SHIRLEY BASIN, WYOMING

by

JACK IVES

Prepared Under a Contract With The
Rocky Mountain Center on Environment
Denver, Colorado

INTRODUCTION

This paper will discuss the environmental impact of open-pit uranium mining in Shirley Basin, Wyoming. The term "environmental impact" is defined here to include those changes to the "natural" or pre-mining landscape 1/ of the Shirley Basin area brought about by uranium mining and associated activities. It is also implied that this impact must be assessed in the context of the much wider area of the State of Wyoming. "Quality environment" is interpreted here as the optimum utilization of the natural resources of the Basin, both in terms of the natural ecosystems of the Basin and of Wyoming as a whole.

Situations such as the one discussed in this report are particularly conducive to polarizing positions of the various interest groups involved, including conservationists, mining companies and government agencies. It is doubtful that any single individual is competent to evaluate objectively the often-conflicting information supplied by members of such varied groups. Our position is that value judgments made by a single individual are often open to question. Wherever possible, these will be avoided. Complete elimination of a bias in discussing such a qualitative problem is probably not possible. Care will be taken to identify those sections of this report which reflect our own analysis of the various qualitative assessments made by special interest groups. We will also take the approach that value judgments must be made; our outline of alternatives and conclusions will reflect our own - that the aesthetics of landscape in their broadest sense must be considered an integral part of an area's non-renewable resources.

1. RECITATION OF THE FACTS

In 1951, uranium-rich ores were discovered in the State of Wyoming near the Pumpkin Buttes in the Powder River Basin of Campbell County. This initial discovery stimulated prospecting throughout the State, and deposits of uranium were soon found in the Gas Hills, Crooks Gap, Northern Black Hills and Shirley Basin areas (23,1,3,13, Fig. 1). Preliminary exploration began in Shirley Basin in 1955-57 (12,11). This was conducted largely by airborne radiometric surveys and core drilling (35,19), neither of which seem to have caused any significant surface disruption. All the deposits are at too great a depth to make surface trenching an economically feasible exploration approach (13). Initially these operations involved at least six companies: Kerr-McGee; Utah Construction and Mining Company; Getty Oil Company; Skelly Oil Company; Homestake Mining Company, and Petrotomics, Incorporated (12,13,18). Petrotomics, Inc. is owned jointly by Kerr-McGee (50%), Getty Oil Company (33%) and Skelly Oil Company (16%) (18). Of these six, all but Homestake Mining Company are still (1969) active in the Basin.

1/ "natural landscape" is here used as a term of convenience; pre-mining economic activity has obviously had its own impact, but the term is appropriate in this discussion.

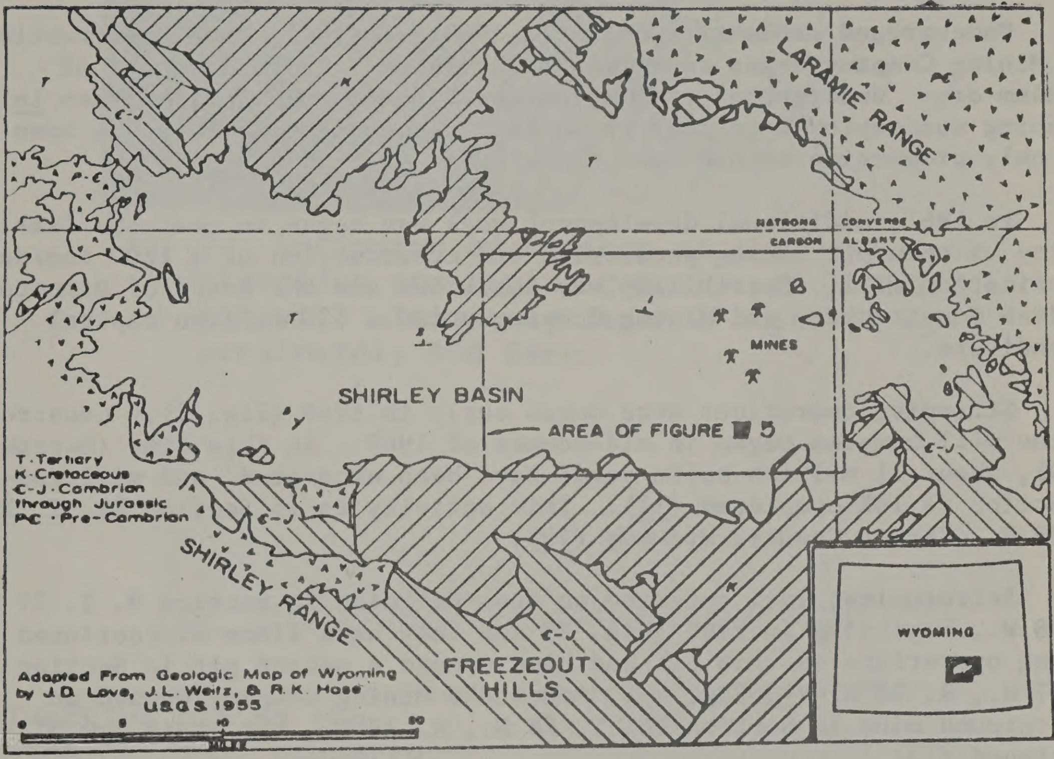


Fig. 1. Generalized geologic and index map of Shirley Basin area, Wyoming (13).

The Shirley Basin uranium area is mainly in the northeastern part of Carbon County, Wyoming between Casper and Medicine Bow (Fig. 1). The deposits lie at depths ranging from 100 to 500 feet below the surface (13,25).

Utah Construction and Mining Company originally staked claims in 1957 under the applicable state and federal mining laws. Development of the properties was undertaken during the next two years to determine feasibility for an underground mining operation. In mid 1959, construction on surface facilities and an underground shaft was begun.

Underground production began in 1960. In 1961, Utah Construction and Mining Company began experiments involving in situ leaching of uranium ore. Underground production was discontinued in 1963 when in situ leaching was employed to meet production requirements. This has been the only production method used since 1963.

In 1967, additional development work was begun to test the feasibility of open-pit mining production and construction of a 1200 ton/day benefication mill. Feasibility was satisfied and the Board of Directors of Utah Construction and Mining Company voted a $20 million capital expenditure.

Stripping operations were begun early in 1969 (Fig. 2). Construction of the mill complex began in mid-summer of 1969. At this time (December, 1969), about 11 million cubic yards have been excavated, and mill construction is 16% completed (11). This activity is in Section 28, T. 28 N., R. 78 W., Carbon County, Wyoming (13).

Petrotomics, Inc. operated an open-pit mine in Section 9, T. 27 N., R. 78 W., beginning in 1960 (Fig. 3) and they have since discontinued mining operations in this pit and have opened a second pit in Section 15, T. 27 N., R. 78 W. (4, Fig. 4). Homestake Mining Company opened an underground mine in Section 26, T. 28 N., R. 78 W., but it is now discontinued (13).

Petrotomics, Inc. is currently operating a mill at the site of their initial pit.

Utah Construction and Mining Company currently controls 11,437 acres in the Basin (11), Petrotomics, Inc. 37,000 acres (10). Utah Construction and Mining Company control is based upon 1,158 acres of patented land and 10,279 acres of uncontested mining claims (11). No similar breakdown is available for the Petrotomics, Inc. land although it is assumed that the majority of their "control" is in the form of uncontested mining claims.

Although the largest deposits of uranium ore are at the eastern end of the Basin in the area of current mining activity, other deposits exist further west as outlined in Figure 5 (13). Initial reserves of the district were estimated to be in the range of 100,000,000 pounds of contained U_3O_8 (13). Host rock for the uranium deposits is an arkosic

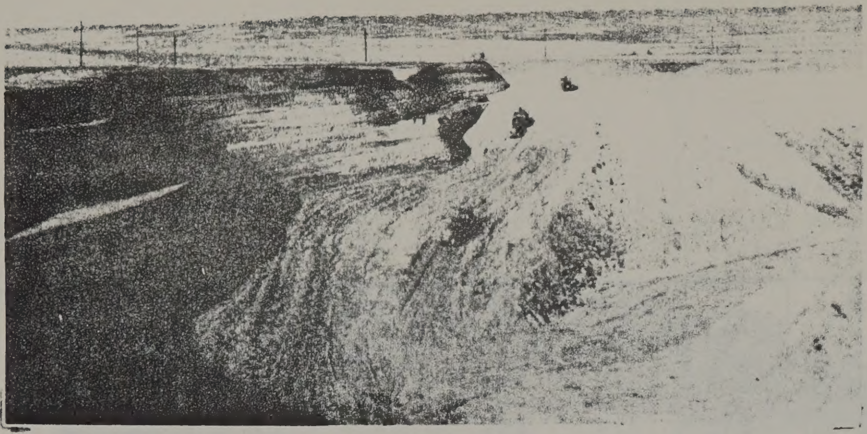
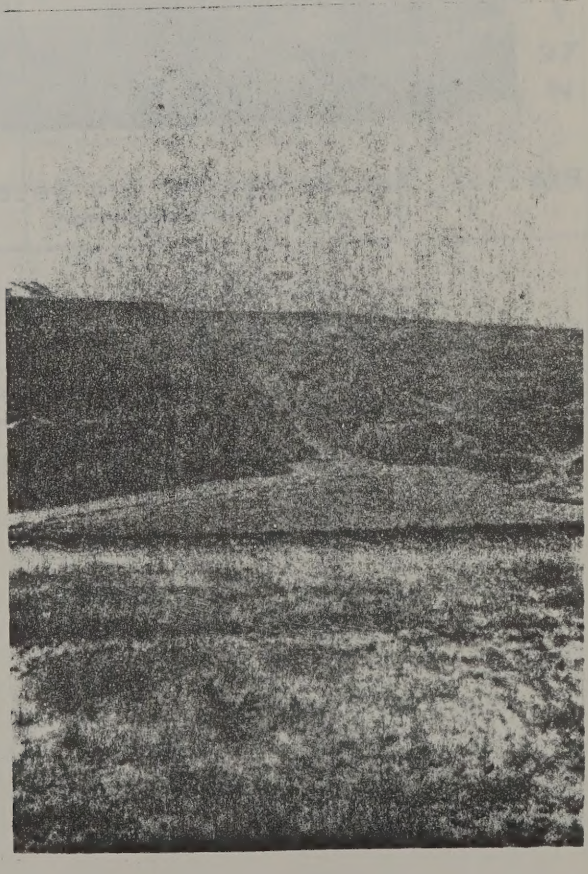


Fig. 2. Stripping operations at the Utah Construction and Mining Company pit. This pit will ultimately reach a depth of approximately 400 feet.

ig. 3. Inactive pit on the Petrotomics, Inc. property. The maximum depth of this pit is between 400 and 500 feet with very high-angle, occasionally vertical walls.



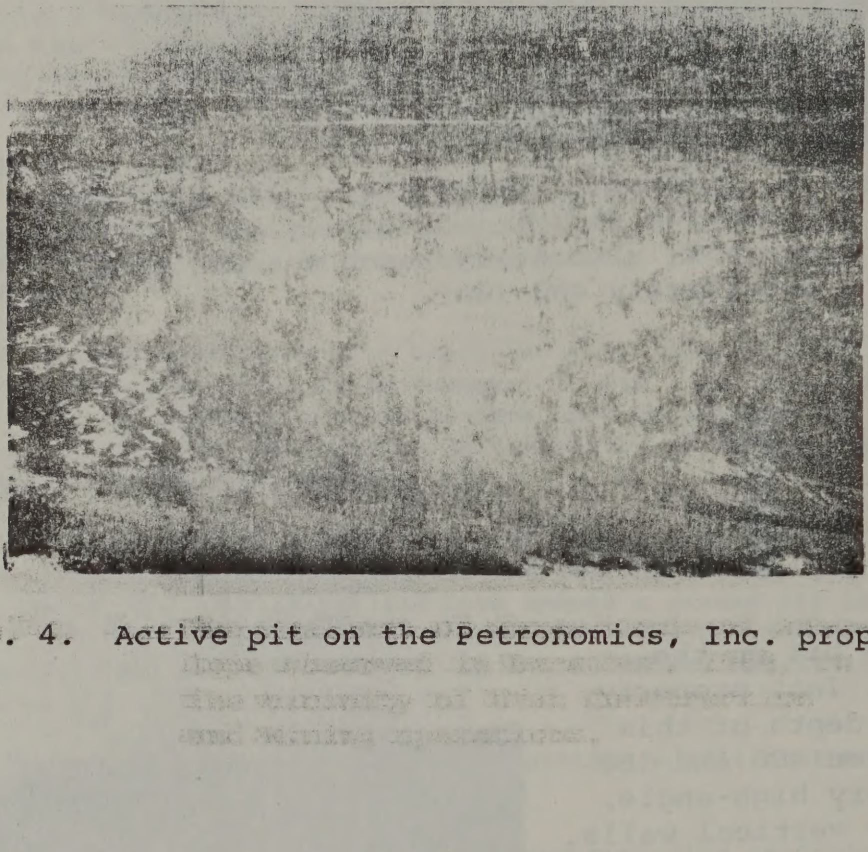


Fig. 4. Active pit on the Petronomics, Inc. property.

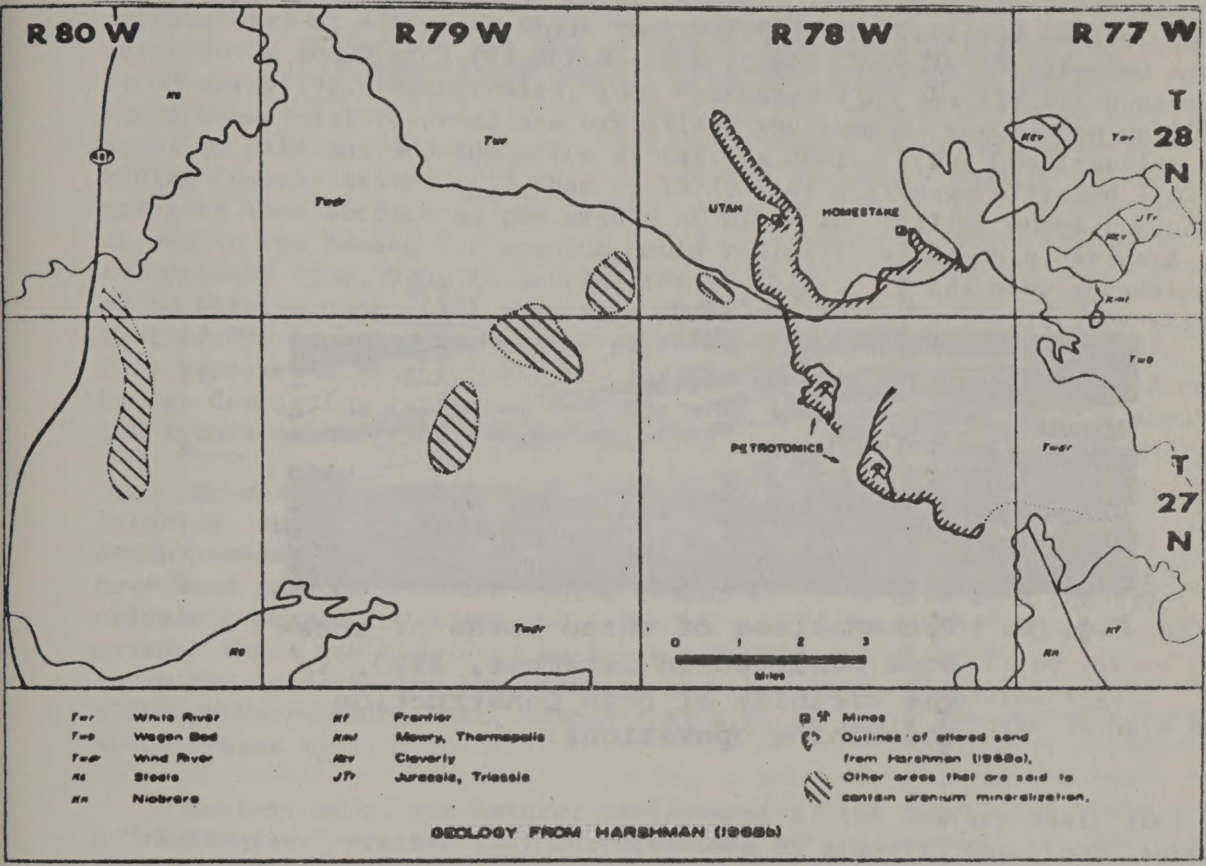


Fig. 5. Uranium mineralization in Shirley Basin (13).

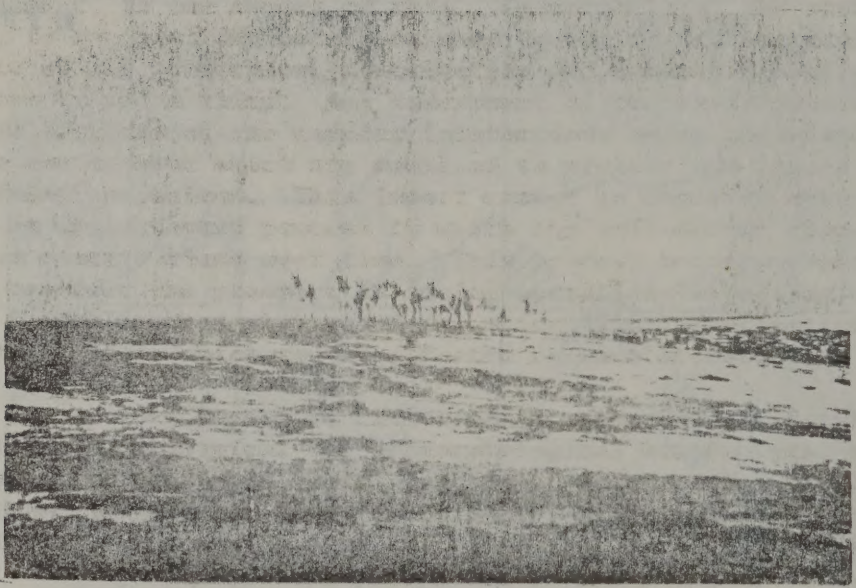


Fig. 6. The smallest of three herds of antelope observed in December, 1969, in the vicinity of Utah Construction and Mining operations.

sandstone of the Wind River Formation of Lower Eocene age and is fluvial in origin. The arkosic detritus, laid down as a coarse sand some 60 million years ago, was largely derived from the Sweetwater Arch area, some forty miles to the west (13). The uranium deposits presumably were emplaced by ground water solutions that leached uranium from large volumes of the Wind River arkose and concentrated it in selected locations by chemical precipitation (13,4).

During our on-site visit to Shirley Basin (2-5 December 1969), we observed three major pits. These included one inactive pit on the Petrotomics, Inc. property and two pits in various stages of development on the Utah Construction and Mining Company property and the Petrotomics, Inc. property respectively. As of October, 1969, the pits covered a surface area of 478 acres while the tailing piles occupied another 583 acres for a total of 1,061 acres. The annual increase in affected acreage is 53 acres (9). Petrotomics, Inc. estimated (18) that if all presently known commercial reserves are exploited, the company would open up 300 acres of pits and 500-600 acres of tailing dumps. Utah Construction and Mining Company states (11) that by 1977, they will have affected 1,027 acres of land surface as the result of mines and tailing dumps. Fluctuations in the demand for uranium could radically alter this estimate. At the present time, U_3O_8 is selling for $6-$8/lb. It has been suggested, as an extreme case, (36) that at a price of $30/lb, a possibility exists that 47,000 square miles of the surface of Wyoming could be involved. This represents roughly half the surface area of the state. (The Atomic Energy Commission estimates that the area involved would be only about 100 square miles "if all known reserves" were developed.)

According to the Bureau of Land Management, U.S. Department of the Interior, approximately 4,600 acres of land were patented in Shirley Basin between 1958 and 1969. An additional 160 acres of private land have been purchased by the mining companies to be used as a townsite; a private exchange involving 440 acres of public lands and 640 acres of private lands was completed early in 1969 (12). There is no record of any state lands having been acquired by the mining companies (12), although Petrotomics, Inc. stated that some of their acreage is held by state leases (10).

Ecologically, the natural environment of the Shirley Basin area is a "short-grass" prairie (24) characterized by grasses, sagebrush, antelope (Fig. 6), deer, sagegrouse, hawks, eagles and smaller mammals such as rabbits and rodents. The average annual rainfall is 6-12 inches (22). The floor of the Basin lies at an average elevation of 7,000 feet above sea level and is largely rolling grasslands with small, intermittent streams draining into the Medicine Bow and North Platte Rivers. From an aesthetic point of view the basin cannot be credited with having any striking scenic attraction (Fig. 7); the most significant aspect of the natural environment is the wide open area used for antelope grazing.

The most conspicuous aspect of the problem of open-pit mining in Shirley Basin is the often contradictory nature of the "facts" supplied by mining companies, government agencies and private individuals. On only one point were spokesmen for the mining interests, government agencies and conservation groups in complete accord; all stated that at the time mining was begun in Shirley Basin, neither economic, political, scientific nor citizen action forces opposed this activity in any way. This may be interpreted as indicating that no opposition did, in fact, exist, but it is our impression that a more reasonable interpretation is that the opportunity to protest was not truly present until mining operations had become a *fait accompli*.

2. ENVIRONMENTAL IMPACT

The current situation in Shirley Basin must be considered from multiple conditions and influences related to the area's open-pit mining operations. Ecology, the study of the relationship of organisms to their environment, is one aspect of this. Geomorphology, the study of landforms, is another, intimately related to the first. Economics, the science of the production, distribution and consumption of goods and services is yet a third. Any assessment of the environmental impact must be made in terms of the complex interactions among these and other aspects of the environment which are modified to greater and lesser degrees by the mining operations. This impact cannot be considered in static terms. It is an evolutionary process to which the influencing elements make various contributions over time. This process becomes especially important if we consider the prospect of mining operations affecting even larger areas in the current absence of any scientific investigation into the regional ecology which may be affected by such operations.

The primary impact of this type of mining on the natural landscape, from both the ecological and geomorphological standpoints, is associated with pits and tailing dumps. This impact is total and involves complete disturbance of the pre-existing surface. At the present time, the affected area represents less than 1% of the total surface area of Shirley Basin. The impact on areas peripheral to the pits, mills and tailing dumps is less obvious and somewhat more conjectural at the present time. This type of impact may be considered an indirect or side effect, but its importance may be several orders of magnitude greater than the direct impact. Again, any estimate of such indirect impact requires specific scientific investigations. Possible effects of the mining operations are: pollution produced by the mining and milling operations; potential surface disruption associated with exploration, road building and assessment work; and the reaction of the animals of the Basin to the presence of man. In each case, potential deterioration of the natural environment exists. In no case, however, were we able to find sufficient data to make a clear-cut prediction that such deterioration would or would not occur.

The following are a representative sampling of the opinions and information volunteered by those with whom the problem was discussed. Mr. Tom Bell, Executive Director of the Wyoming Outdoor Council stated, ". . . there is no question but that the mining operations in the Basin are detrimental to the antelope herds there." (21) Mr. Fred Yeaman, District Director of the Wyoming Game and Fish Commission in Casper, Wyoming stated that ". . . mining may have an impact on the antelope and sagegrouse in Shirley Basin but there is no available data." (20)

Mr. Yeaman did not give his reasons for this statement. A Wyoming Game and Fish Commission Internal Report (16) states that a 39% decrease in the antelope herd of the Basin occurred between August 1960 and August 1969. The nature of this decrease with time was not defined nor was the area over which the study was conducted. This report concluded that, "It is doubtful that the proposed expansion of the uranium mining and processing will be of any benefit to antelope populations in the area." Again, no reasons for the decrease of the population or for the conclusion were given; without careful study controls such unqualified results could be accounted for as natural fluctuations of herd population. A survey of hunting success (20,38) for the Shirley Basin area for the period 1960-1968 suggests that the general health of the herd may actually be increasing. Due to natural hunter selectivity, buck antelope are harvested first and the ratio of bucks to does harvested is a rough index to herd numbers. The ratio of bucks harvested to the total harvest increased in essentially linear fashion from 76.6% in 1962 to 96.8% in 1968. Hunter success (the ratio between the number of permits issued and number of permittees harvesting an antelope) increased, again in essentially linear fashion, from 83% in 1960 to 94% in 1968. It should be pointed out that during this period, the boundaries of the Shirley Basin permit area were revised. The presence of new boundaries makes it difficult to compare the annual statistics in terms of a trend. Nevertheless, the constantly high percentages do indicate that, at least from the hunters' standpoint, mining is not interfering with the propagation of antelope within the Basin. These statistics, of course, do not deal with the absolute variations which may be occurring in the antelope population. They only reflect the relationship between hunters and antelope. Studies are required to evaluate the combined impact of mining and hunting on these herds rather than studies considering them as independent entities. This again points up the need for rigorous scientific investigation.

A study of the mining impact on sagegrouse concluded that, ". . . while . . . the loss of this particular site is not of great detriment to sagegrouse when considered alone, the increasing destruction of sage brush throughout the state increases the importance of the sage brush habitat at any location." (16)

A detailed study was conducted on the impact of waste water discharge from the mining and milling operations on trout (15). In this report, it was emphatically stated that the level of radioactive pollution originating from these sources was, at the time of the study, at least two orders of magnitude in excess of the lethal limit for trout and three orders of magnitude in excess of Atomic Energy Commission (AEC) standards for process effluents. This report further states that twenty-four songbirds were collected around the Utah Construction and Mining Company's settling basin in 1961 whose death was attributed to radium poisoning.

Responsibility for monitoring water quality of the Basin rests with the AEC and the Wyoming Public Health Service. The AEC is responsible for process water--that in which the natural level of radioactivity has been raised by a production process. The Wyoming Public Health Service is responsible for those effluent waters which have undergone no processing.

The Atomic Energy Commission (25) has set standards which mine and mill operators must meet. These are largely based on the presence of Radium 226 and state that this isotope cannot be present in amounts greater than 3 x 10^{-8} microcuries per milliliter in any effluent discharged by a production process. Water samples are collected every two weeks. The Wyoming Public Health Service does not collect water samples within the Basin itself but rather collects bottom samples of mud from the Medicine Bow River outside the Basin and measures both α and β radiation levels. Spokesmen for both these agencies (24,27) stated that the level of radioactivity in the liquid effluents from the mine and milling activities is far too low to have contributed to the death of either trout or songbirds. In the face of this seeming conflict of evidence, we can draw no conclusion about the lethal nature of the surface waters of Shirley Basin. On the other hand, the degree of conflict of data presented would seem to warrant close investigation into the sources of the different data.

For a time, Utah Construction and Mining Company experimented with an "in-place" leaching technique by which a 5% solution of sulfuric acid is pumped, through a drill hole, into a uranium-rich zone; the resulting concentrate is then pumped back to the surface. Potential ground water pollution resulting from this technique exists, but once again, there is some ambiguity as to its nature. The uranium was originally concentrated by chemical precipitation resulting from pH changes in the uranium-rich groundwater solutions which percolated through the Wind River Formation. The ultimate extent of this source of pollution is largely dependent upon the present range of pH values within the sediments of the Basin and the chemical composition of the stratum into which the sulfuric acid is being pumped. Values for these parameters are not available to us. Consequently, we can state only that the possibility for groundwater pollution as a result of "in-place" leaching exists but will remain conjectural until studies are conducted.

In terms of air pollution, the State of Wyoming has set specific standards for levels of various pollutants (28). At the same time, the law apparently contains no provisions for monitoring these standards. Presumably an "interested party" must file a complaint in order for action to be taken. No evidence was found indicating that such a complaint has ever been filed regarding mining activities in Shirley Basin. Without detailed knowledge of present and anticipated levels of air pollutant discharge and the nature of the pertinent climatological parameters in Shirley Basin, we feel that any speculation on the present and prospective level of this type of environmental impact is not possible.

Man's relationship to the environment of Shirley Basin certainly involves the effect the mining has had, or will have, upon the area's scenic resources, wilderness values and outdoor recreation potential. This is a very subjective issue. Opinions, in most cases, were quite predictable. Conservationists flatly opposed the mining operations. Spokesmen for mining companies normally supplied information indicating how their activities were enhancing some aspect of the area. Individuals associated with government agencies generally reflected the primary interest of their agency, e.g., Game and Fish Commission personnel were commonly opposed to the mining while Geological Survey employees felt that the scenic and wilderness considerations were insignificant when compared with the value of uranium ores to the general economic well-being of the people living in the vicinity and in the state. It is our opinion that an aesthetic evaluation of the mining operations in Shirley Basin by one person is largely meaningless. As extreme examples, one may conclude either that the unspoiled surface of the Basin is attractive or that deep holes in the ground are much more interesting than a flat prairie. However, to generalize either of these opinions into a statement which is meaningful to all those who might visit Shirley Basin cannot be justified. Certainly Shirley Basin cannot be classed as a regionally or nationally-recognized scenic attraction. However, the growing nationwide pressure on wilderness areas must be taken into consideration. Spokesmen for Petrotomics, Inc. (26) and the Wyoming Department of Economic Planning and Development (19) have both stated that tourism with the Basin has increased as a direct result of the mining activities there.

It has already been stated that the economic impact of uranium mining must be considered as part of the total environmental impact. A corollary of this is that man is a part of the environment of Wyoming and, as such, must be given at least equal ranking with the biota of Shirley Basin. The mineral fuels industry of Wyoming, of which uranium mining is a part, is an integral part of the State's economy. During the period June 1967 to June 1968, 9.4% of the State's labor force was employed in some aspect of the mineral fuels industry (8). As of 1967, 1,346 men and women were employed by the uranium mining industry in Wyoming (29) at an average pay for production workers of $3.25/hour (30). In 1969, approximately 600 individuals were employed in Shirley Basin alone (18,11). It is estimated that this figure will double inside a year or eighteen months (2).

In 1967, 244,000 tons of ore were mined in Shirley Basin (31); production and property taxes amounted to $1.07 per ton (32) or somewhat more than $250,000 were paid to the State of Wyoming. This tonnage accounted for slightly more than one-fifth of the 1967 Wyoming production of U_3O_8 (33). The gross value of all uranium concentrates sold by Wyoming producers through 1967 was $372 million. Much of this gross value is directly beneficial to the State of Wyoming in the form of salaries, taxes and expenditures for fuel used to power the mining and milling machinery, sulfuric acid used in the leaching process, utilities (electricity and natural gas)--all of which are purchased within the State (34).

It may be perhaps legitimately argued that the economics of the State of Wyoming has little to do with an environmental discussion of Shirley Basin. We certainly make a value judgment to say that the residents of the State are entitled to something more than an untouched natural environment if there are to be residents of Wyoming at all. It is ultimately a question of the proper balance that will provide a quality standard of living for Wyoming residents while maintaining a quality natural environment. Many suggest solutions to this question as

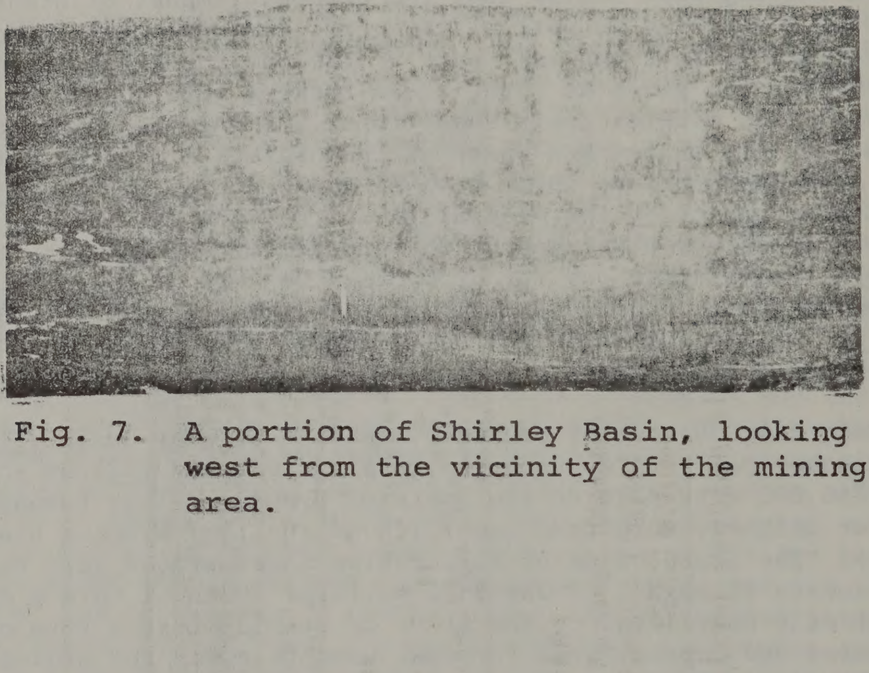


Fig. 7. A portion of Shirley Basin, looking west from the vicinity of the mining area.

an "either-or" situation. Those who advocate continuation of largely-unregulated mining practices of the past are out of step with a growing public awareness of the finite, non-renewable quality of this country's natural resources. Those who would completely halt all mining in Shirley Basin (and similar areas elsewhere) do not seem to appreciate the energy requirements of the United States during the latter half of the twentieth century. It is highly relevant, however, to consider how disturbance of the "natural" environment can be kept to a minimum.

3. PROBLEM ORIGINS

A multitude of causes may be cited as probable reasons for the present type of mining activity in Shirley Basin. These are geological, legal, political, economic and social in nature.

Geologically, the situation originated in the Late Eocene with deposition of the Wind River Formation which contains uranium deposits. The alluvial, semi-unconsolidated nature of this formation has contributed to the fashion in which the technique of uranium ore extraction has evolved. These deposits are quite shallow, diffuse (Fig. 8), and copious ground water is present. Under these conditions, it has proven less expensive to mine the uranium ores using open-pit techniques rather than underground methods (37). It has been estimated that, given the present level of technology and the present market price of U_3O_8, a depth in excess of 600 feet of the uranium-rich ores is required to make underground mining economically competitive with open-pit methods (38). This estimate represents a value judgment, of course, that does not place quality of environment on the debit side but rates it as irrelevant, expendable.

From a legal standpoint, mining operations in Shirley Basin are based primarily on the General Mining Laws of 1872. In terms of providing any significant control over either exploration or development, it is our impression that this law is virtually ineffective. In order to be effective, legislation must control mining activities through the staking and recording of claims, exploration procedures, producting and reclamation. It is apparent that the present level of technological development and mineral utilization was not anticipated by the formulators of the General Mining Laws of 1872. Under the General Mining Laws, the Bureau of Land Management of the Department of the Interior is the agency with primary responsibility for enforcement. There is no requirement, however, that the BLM even be notified of the staking of a claim. These claims are recorded with county authorities. The BLM may act only if the validity of a claim is challenged (14). In regard to the mining in Shirley Basin, an official of the BLM stated, "The BLM has no control over mining operations of this type." (12) In checking on the validity of this statement, we were told by the Assistant to the State Director of the Bureau of Land Management that the only change that might be made is to insert the word "valid" before "mining operations." He further stated that the BLM does not have the authority to initiate proceedings to determine the validity of a claim but must wait for a complainant to come forth.

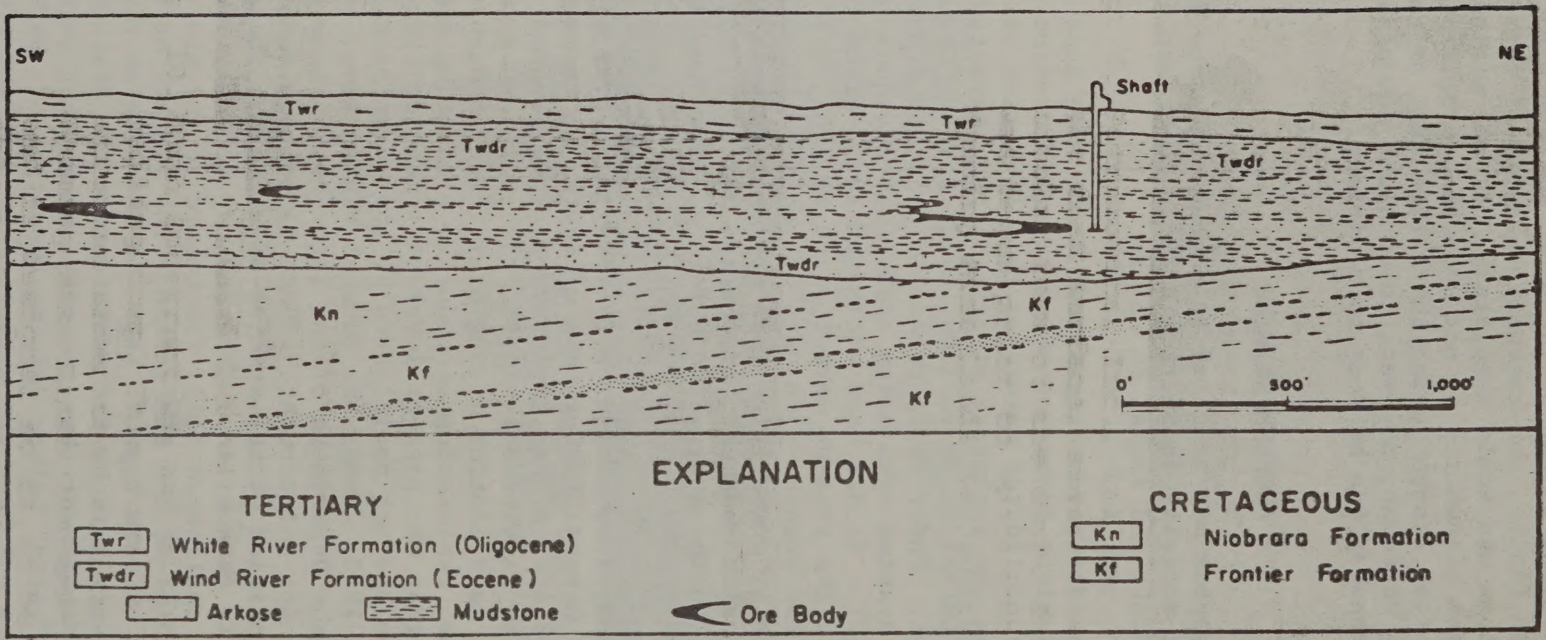


Fig. 8. Generalized section through Utah mine area, looking northwest (13).

Prior to 1969, the State exercised little control over the general conduct of mining operations and none over mined-land reclamation. In 1969, the State adopted the Mine Lands Reclamation Act. The stated policy of the Act is to provide for the reclamation and conservation of lands subjected to disturbance by open-pit mining. Unfortunately, as yet, the State has little experience or data which allows it to set specific standards for such reclamation or conservation. It was stated (6) that this Act would be amended as such experience and data become available. We feel the Act, even in its present vague form, has had some impact. A comparison of pre- and post-Act mining company practices, at least with regard to tailing dump construction (Figs. 9-10), indicates that these companies have been influenced by the passage of this Act.

It appears to us that political interests in Wyoming actively support mining in the State. Both the Wyoming State Land Commissioner's office (6) and the Wyoming Department of Economic Planning and Development (19) stated that they felt mining was good for the State and encouraged this activity in every way. Interestingly, some evidence is available that a report critical of certain aspects of the mining operations in Shirley Basin and originated by a federal agency was ignored by the responsible State official (15).

We assume that political, social and economic interests are closely linked. In an admittedly unstatistical attempt to assess the attitude of the local residents to the mining operations, ten individuals in the town of Medicine Bow were asked about their reaction to the open-pit mining in Shirley Basin. Of these ten, two were not aware that mining was in progress in the Basin; the remaining eight were unanimously in favor of the mining operations, primarily on economic grounds. While it cannot be claimed that this was a random, unbiased sample since it was conducted in only one town on a spur-of-the-moment basis, it does suggest that there is not strong social pressure against the mining of uranium as it is being conducted.

It would seem that the mining operations, as they have developed in Shirley Basin, are the result of: (1) economic constraints on the mining companies resulting from the market price of uranium oxide and the nature and location of the ore bodies; (2) the almost total lack of legal constraints on the mining companies during claiming, exploring and mining activities; (3) the economic needs of the State of Wyoming which have produced a political climate favorable to unrestricted mining. These three factors have militated against the development of effective environmental impact studies.

4. ENVIRONMENTAL CONSIDERATIONS AND ALTERNATIVES

No evidence was uncovered to indicate that any ecological considerations were made with respect to the actual or probable impact of open-pit mining in Shirley Basin. Policy decisions seem to have been controlled entirely by economic considerations. The lack of ecological concern seems to stem from two basic problems. First, there is little

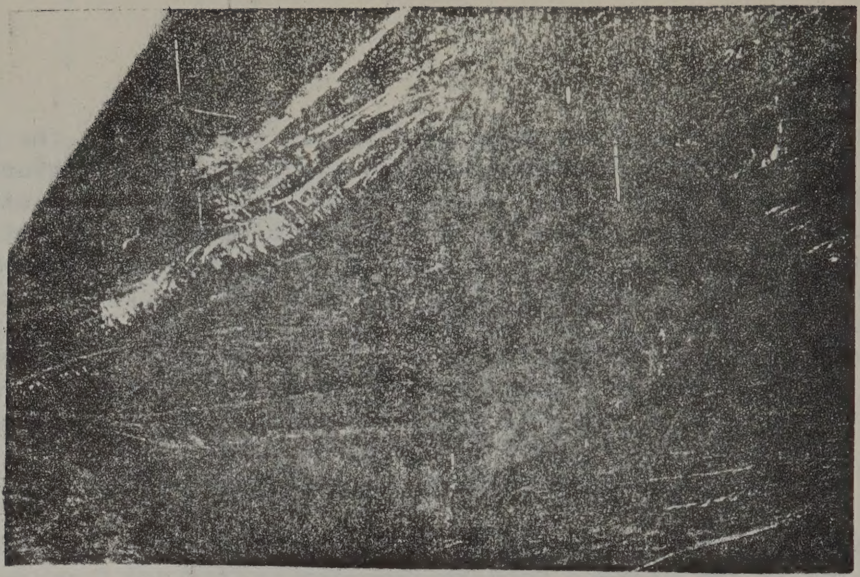


Fig. 9. Petronomics, Inc., tailing dump. Note the flat surface, steep sides and tabular form of the dump. This dump was begun prior to enactment of the Wyoming Mine Lands Reclamation Act.

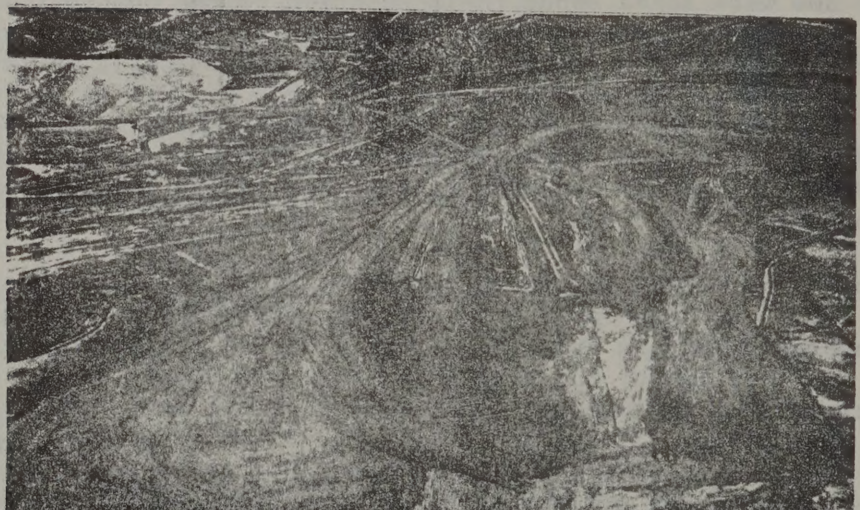


Fig. 10. Utah Construction and Mining Company tailing dump. This dump is being constructed under the provisions of the Wyoming Mine Lands Reclamation Act and is designed so as to be conformable with the pre-existing topography.

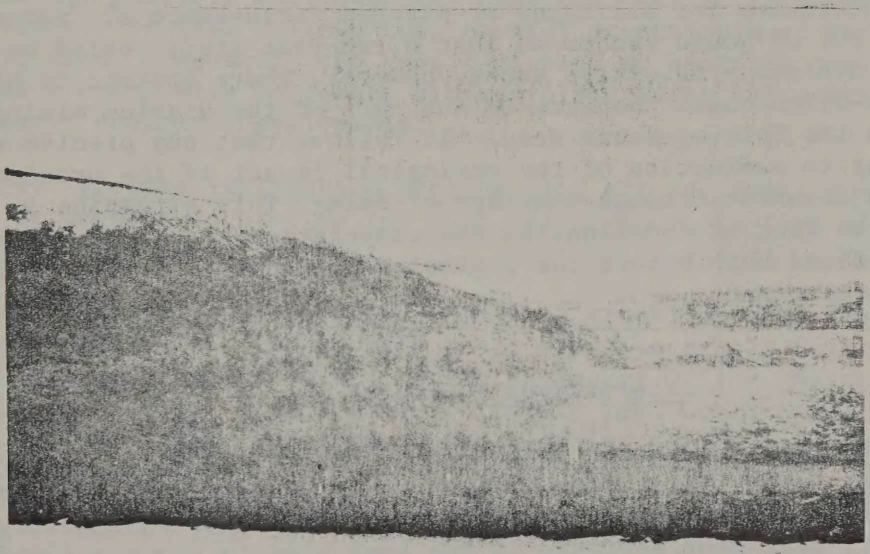


Fig. 11. Natural revegetation on a Petronomics, Inc. tailing dump three years after cessation of dumping. The vegetation is generally patchy, consisting of grasses with no sagebrush evident.

quantitative information available on which to base such considerations and secondly, there is a definite lack of coordination and cooperation among the governmental agencies involved, on both the federal and state levels. No public hearings were required by law in this case, and none were held.

A valid determination of the ecological impact of any activity requires that sufficient time be allowed for a scientific investigation so that a full evaluation can be made of the pre-disturbance ecology; the investigation should follow through with post-disturbance monitoring. Referring to the urgent need to determine possible ecological impact of weather modification projects, Cooper and Jolly (5) recommend a five-year period of scientific investigation of a weather modification target area prior to the beginning of such modification. The five-year period may not be necessary for all types of planned disturbance of "natural" ecosystems, but we would recommend that a two-year study period be regarded as a minimum. As stated above, however, there appears to have been no "pre-disturbance" concern on the part of the uranium mining interests in the Shirley Basin area. It follows that any precise statement relating to evaluation of the ecological impact of the uranium mining would flounder through shortage of data. This situation is compounded by the lack of coordination and cooperation among the government agencies involved both before the beginning of mining activity in 1958 and up to the present.

Alternatives - General

(a) The first and most obvious is a complete revision of the General Mining Laws. These Laws are generally vague and have proven to be largely ineffective in seriously influencing the mining industry. In particular, pertinent sections in the Laws need to be re-defined in terms of modern technology. The Laws themselves need to be expanded to cover all aspects of mining operations: the staking and recording of claims, exploration, production and reclamation. It would be useful if responsibility for enforcement of the Laws could be vested in a single government agency. A significant improvement could be realized by making all minerals subject to lease rather than claim.

The distinctions between "placer" and "lode" claims have been gradually blurred by advances in technology until, today, these two categories serve more to complicate, rather than simplify, the application of the Laws.

(b) Mining companies should be encouraged to divert a percentage of their expenditures to studies of surface reclamation and pollution control by amending appropriate laws, such as the Mine Lands Reclamation Act of 1969, or by passing new laws where need exists.

Subsequent to filing a claim or applying for a lease, the claimant could be required to postpone initiation of exploration and production for a period of two years during which time a general inventory of the total ecosystem could be conducted, all pertinent pre-existing ecological data could be evaluated and a report on the results of such studies submitted to the responsible government agency together with recommendations. Ideally, the ecological research would be undertaken by an agency or group independent of both the mining interests and the government regulatory body. The period set aside for ecological investigation could also be used to hold public hearings and to insure full-scale evaluation of all economic and ecologic considerations. In view of the long-range planning required in most major mining operations today, it is unlikely that delay resulting from predisturbance research would cause undue hardship to the mining companies. Absolutely basic to the success of any such research endeavor, however, is the need for a quantitative approach to cost accounting of the aesthetics of the target area and the possible environmental loss that may be incurred by mining disturbance. It also follows that careful attention must be given to the economic need; frequently the result of such an approach could be anticipated as a compromise to insure minimum disturbance in relation to "necessary" economic development.

(c) Present legislation dealing with air and water quality standards should be amended to provide for more effective monitoring of potential sources of pollution.

(d) An inter-agency group should be established to coordinate the activities of Federal and of such state agencies as the Soil Conservation Board, State Geological Survey, State Engineers Office, Water Conservation Board, Game and Fish Commission, State Land Commission, State Public Health Service, State Development and Planning Commission.

(e) States should be encouraged, by Federal legislation, to consider air, water, land and other aspects (including aesthetics) of the natural environment as non-renewable resources, thereby giving them an economic value more competitive with commercial products. It is our opinion that uranium mining may be producing hidden costs through environmental pollution which are neither well understood nor properly compensated for.

Alternatives - Specific

(a) A study of tailing dump geometry should be undertaken to determine optimum design criteria. The present assumption is that ideally, tailing dumps should be conformable with pre-existing topography. It is possible to suggest, however, that such conformity results in the despoliation of a larger surface area per unit volume of tailing material than conventional dumping. Given a situation in which attempts at revegetation are only marginally successful, it could well be that far more surface area will be adversely affected on a long-term basis than would be the case with the "tabular" dumps. An in-depth study of this problem involving rate of revegetation, (Fig. 11) surface area involved in the various tailing dump configurations and the optimum surface area/volume relationship needs to be undertaken. This study could be expected to yield useful results well within the anticipated duration of the mining activities in the Basin.

(b) An extensive survey of the extant literature relevant to ecological relationships of Shirley Basin in particular, and short-grass prairie ecosystems in general, should be undertaken to identify the more pressing problems related to the impact of open-pit mining on the environment. As these problems are identified, they can become the subject of on-site investigation. Until this is done, the ecological impact of the mining is largely a matter for subjective speculation.

(c) The legal status of the lands controlled by the mining companies should be investigated and clarified. This investigation should include total area under the control of the companies, types of lands involved (state, federal, private), types of control (lease, patent, uncontested claim), the present and proposed use of these lands (mine, mill, tailing dump, townsite) and the correspondence of these various aspects of land use with existing laws.

(d) The present level of radioactive materials in the surface and sub-surface waters of the Basin should be measured in an attempt to resolve conflicting statements that were encountered during the present study.

(e) Any amendments to existing mining laws should insure that the mining companies, as primary beneficiary of the mining activities, pay for at least a proportion of any ecological research conducted in the area.

(f) The final determination of the technique of ore extraction (open-pit, *in situ* leaching, underground mining) should not be decided solely by maximum profit considerations of the mining companies. This decision should be made in conjunction with the responsible government agency and be based, at least in part, on a minimization of the ecological impact, consistent with an ultimate net profit to the industry. It is understandable that industry attempts to maximize its profits. This motive, however, is not always consistent with the welfare of groups outside the industry. Since technological alternatives do exist, it seems to us that these alternatives must be evaluated in the interests of society as well as those of the mining companies. Such an evaluation would necessitate a value assessment of the possible environmental impact of mining operations.

5. CONCLUSIONS

The Indians of the southwestern United States often raid the caches of squirrels and other rodents for pinon nuts, but they are always careful to leave corn or some other grain in return. In this way the balance of nature is preserved.

At the present production rate of waste products, man will soon render this planet uninhabitable, at least for his own species. The problem does not seem to us insoluble. While there will always be a conflict between those who wish to preserve the essential, unspoiled natural environment and those who favor unrestricted exploitation, it is apparent that we must look for optimum solutions. While much remains to be done in the fields of scientific and technological solutions to pollution, much more information presently exists than is being utilized. Many of our environmental problems can be solved by enforcing existing laws and by collecting and making available data useful to regulatory agencies charged with such enforcement.

This study could not provide definitive analyses or suggest specific solutions for many aspects of the Shirley Basin problem because this would require original research beyond scope and time limitations. We are confident, however, in making several firm and highly relevant conclusions:

(1) the problem is characterized by legal anachronisms -- nineteenth century mining laws could never have anticipated decades of massive advances in technology;

(2) lack of effort on the part of the mining companies to determine possible environmental disturbance prior to causing such disturbance;

(3) little evidence of effective collaboration between the various private, public and governmental groups involved;

(4) general absence of usable scientific data on the ecology of the "target area."

A fitting conclusion for this report are the observations of a man who perhaps best exemplifies the position of the concerned pragmatist John F. Kennedy.

> Our primary task is to increase our understanding of our natural environment to the point where we can enjoy it without defacing it, use its bounty without permanently detracting from its value and, above all, maintain a living, evolving balance between man's actions and nature's reaction. For the nation's great natural resource base is as elastic and as productive as our ingenuity and skills.

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CASE STUDY NO. V

COPPER PIT MINING COMPOSITE, ARIZONA

by

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Rocky Mountain Center on Environment
Denver, Colorado

INTRODUCTION

Early mining for copper in Arizona was based on high grade ore and unsophisticated methods of mining. Most ore was mined underground because large-scale equipment needed to remove the masses of overburden waste material was not available. With the advent of improved smelting techniques and large-scale equipment, mining of ore with no more than 0.35% copper was economically feasible by open pit techniques; thus we see the development of large pits as low grade ore is removed at greater and greater depths. However, improved techniques in underground mining and high grade ores found at greater depths may cause underground mining to be the dominant method in the future.

Background to the Case History Areas

The increase in open pit mining caused additional waste disposal problems, with waste originating from overburden and rock removal as well as from ore processing. Underground mines continue to operate in Arizona at Superior, San Manuel, Bisbee and other towns, but these do not contribute as much to the total copper production in Arizona as do the open pit mines. Open pit mines, including those at the two case history areas -- (a) Anaconda Copper Corporation's Twin Buttes Mine and Duval Corporation's Sierrita Mine (both south of Tucson near Sahaurita), and (b) the mining complexes at Miami, Superior, and Hayden, Arizona -- along with underground mines, produce more than 50% of the copper production in the United States (1). These mines also produce other minerals such as silver and molybdenum.

The case history areas are uniquely different and yet the problems and possible solutions appear to be similar.

(1) Sahaurita Area

Anaconda Copper Corporation's Twin Buttes Mine

This mine took five years to develop and has been in operation only for the last year. The first five years were used to remove 550 feet (230 million tons) of alluvial overburden which covered ore-bearing rock (5). This overburden is being used for 230 feet high dikes (Fig. 1) to contain tailings which are only beginning to be produced (Fig. 2) as the company processes ore-bearing rock. Waste rock, or rock with little present economic value, is being piled into large "mountains" on the site.

Duval Corporation's Sierrita Mine [1]

Early development of this mine started in 1967 and 1968. This area is only three miles from the Twin Buttes Mine but at a higher elevation.

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[1] Information pertaining to the Duval Corporation's Sierrita Mine was obtained from Dean W. Lynch, Land Engineer, Duval Corporation, Tucson, Office.

Fig. 1. Alluvial dikes (230 feet high) to contain tailings at Anaconda Copper Corporation's Twin Buttes Mine.

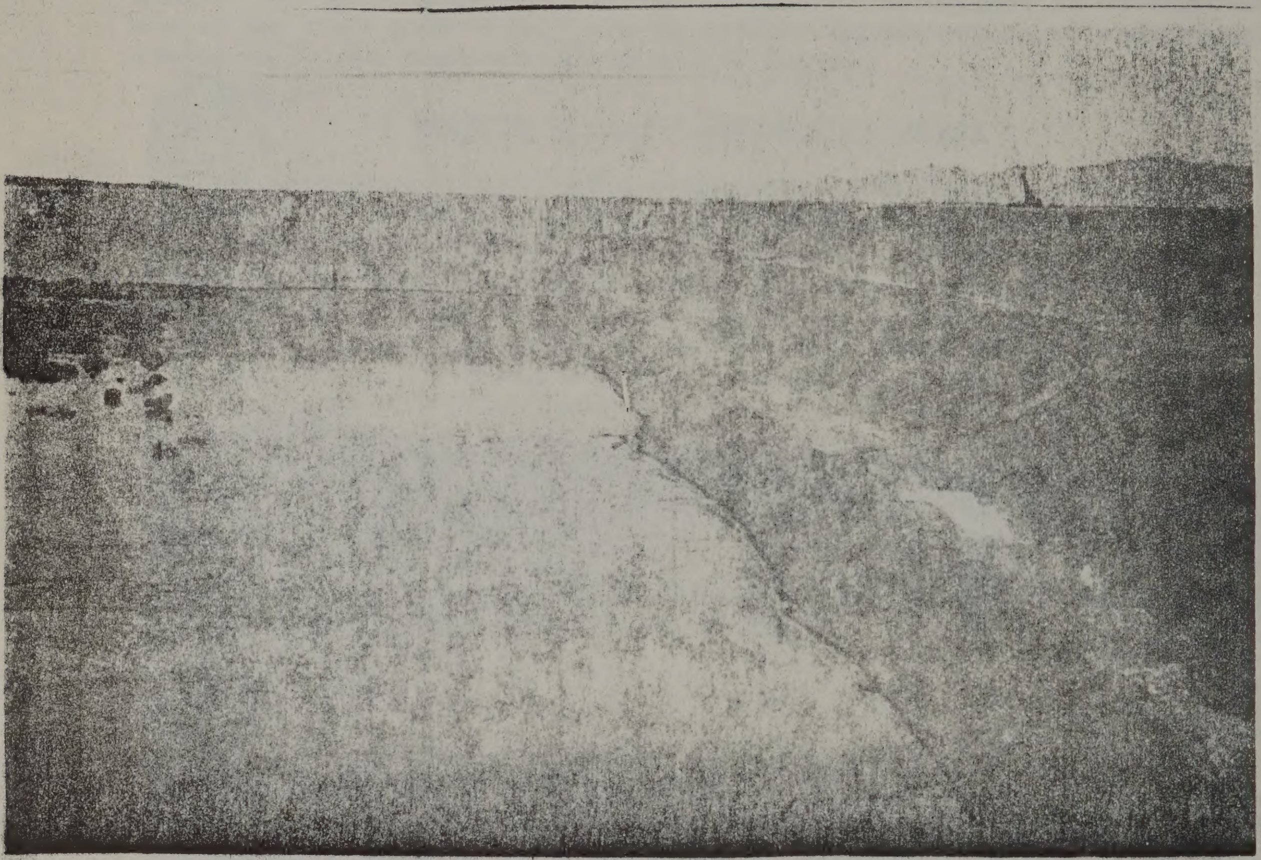

Fig. 2. Tailings filling behind alluvial dike and inundating desert vegetation, Twin Buttes Mine.

Overburden is not alluvial but is similar to the waste rock that is interspersed with the mineralized rock. These are being piled in "mountains" as at the Twin Buttes Mine (Fig. 3). Dikes for containing tailings are being constructed by scooping out desert alluvium to form the lower base (Fig. 4). The upper parts of the dikes will be constructed of coarse tailings material after the tailings pond has filled to the upper level of the alluvium. The dikes are not complete and no tailings are being deposited in this area. However, the dikes for the Sierrita Mine are being constructed so the tailings pond formed behind them will engulf the tailings pond from Duval Corporation's Esperanza Mine which was developed in this area in the late 1950's (3). The Sierrita Mine is producing massive amounts of very low grade ore bearing rock which is presently being leached (through water percolation) for copper extraction (Fig. 3).

Problems in the Sahaurita Area

Both of the case history mines in the Sahaurita area are developing large embankments to contain tailings. These manmade "cliffs" at both mines are only a few miles from the Arizona retirement community of Green Valley and extend for more than six miles across the valley. The citizens of Green Valley are not happy with the development (Appendix I) and have voiced their opinions to the Pima County Planning and Zoning Commission. Steve Emerine, Co-Publisher of the Green Valley News, states,

> If the beauty of the Santa Ritas were marred by the tailings piles now present on the west side of the valley, it would be a great loss to the state. In just six years, residents of Green Valley have seen their once-beautiful western mountain view disappear, thanks to mine tailings. [2]

There has also been some concern over the blowing dust from the mining operations, air pollution from the generator plants at the Twin Buttes Mine (Appendix II), and a falling water table in the Santa Cruz Valley due to excessive pumping by the mines (Appendix III). Problems of the mines' possible impact upon wildlife, recreation and watershed use have not concerned the citizens as much as the esthetic impacts. These problems will be discussed in greater detail under Environmental Impact.

(2) Miami-Superior-Hayden Areas

These areas include land that has been mined since before the turn of the century (3). In most cases the land used is privately owned (from mineral patents). All of the original mines were underground, but the processing of the ore produced massive amounts of tailings. In the early mining days, tailings were deposited in the most accessible location;

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[2] Contained in a letter dated December 16, 1969 to the author of this report.

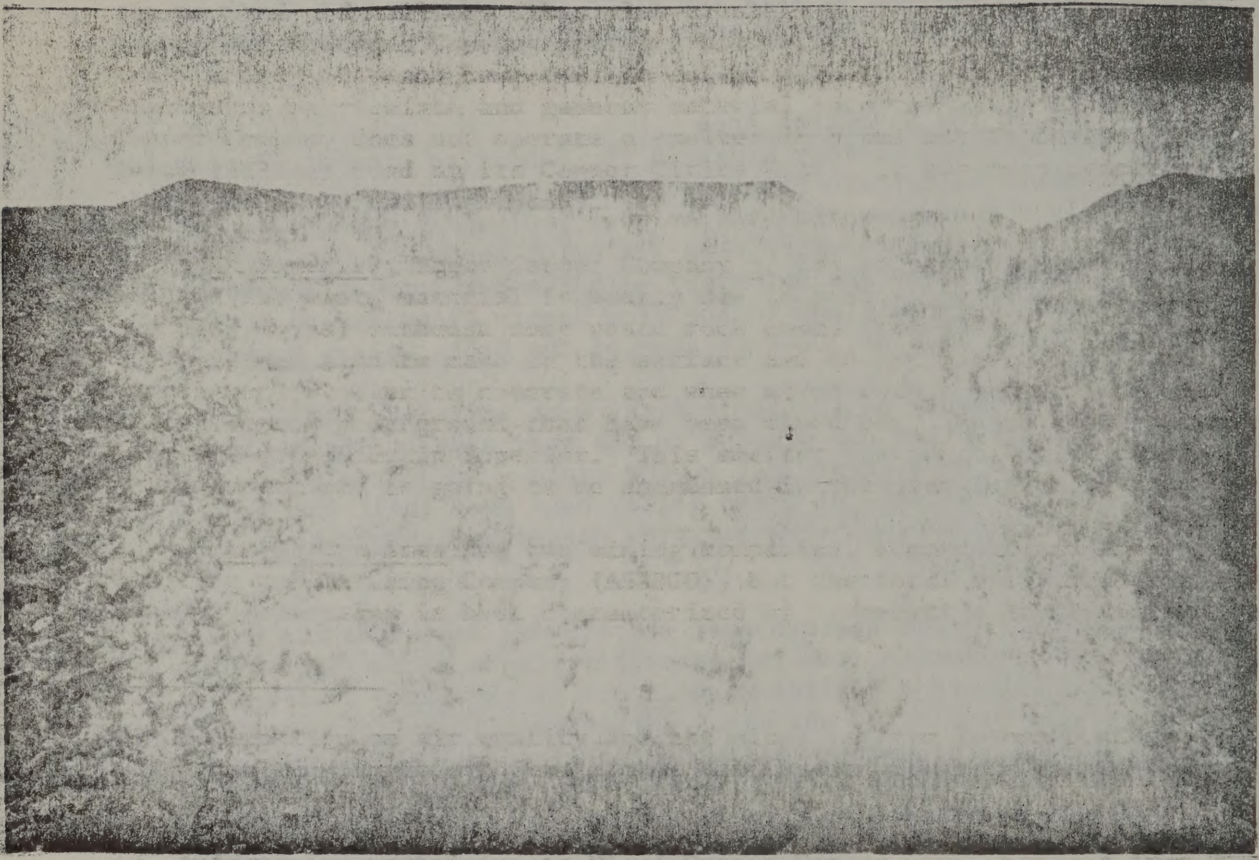
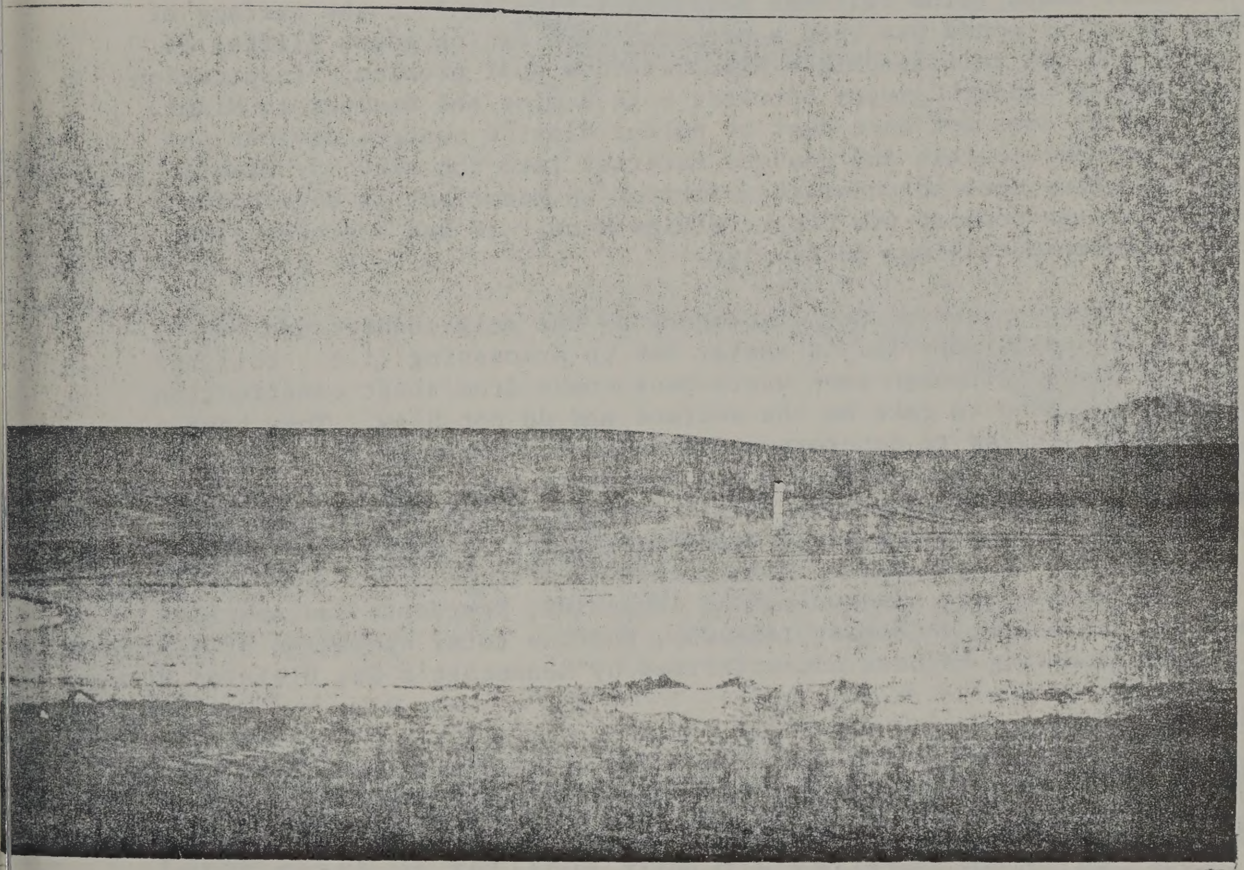


Fig. 3. Mountains of waste rock and low grade ore at Duval Corporation's Sierrita Mine. The stained rock pile in the background is being leached.



ig. 4. Dikes (background) being formed from alluvium scooped out of the desert (foreground) at Duval's Sierrita Mine.

thus today we find giant cliffs of tailings material "in town" (Fig. 5) because of the development of towns around the mining areas. The towns in these areas are mainly mine-oriented and economics dictate the response of the people: there are few complaints (Appendix IV). However, many of the tailings areas are easily windblown and dust has been a continual problem in the towns. With the advent of open pit mining of low grade ore, increased waste material developed and the related problems of deposition and stabilization accompanied it.

Miami at present has only open pit mining. Some tailings ponds from earlier underground mines as well as from open pit mines have been abandoned. Dust (fine tailings particles) blowing from the surface of these dried up ponds has been a problem. The facing edges (lifts) of the new and old tailings dikes also create a dust problem. Inspiration Consolidated Copper Company operates both a mine and smelter in Miami. This smelter does not have dust or sulfur dioxide control devices and discharges particulate and gaseous material into the air. 3/ Miami Copper Company does not operate a smelter in Miami but is developing a large tailings pond at its Copper Cities Mine. It has been concerned about abandoned tailings ponds. 4/

At Superior, Magma Copper Company 5/ has only underground mining so that the waste material is mostly due to processing (i.e., tailings and slag dumps) although some waste rock comes from shaft construction. The tailings tend to cake on the surface and do not blow. They have a consistency similar to concrete and when mixed with cement can be used to fill areas underground that have been mined out. Magma Copper Company operates a smelter in Superior. This smelter has no pollution control, is outdated, and is going to be abandoned in the near future.

The Hayden Area has two mining companies, Kennecott and American Smelting and Refining Company (ASARCO), but the total operation of mining through processing is best characterized by Kennecott's Ray Division Mine 6/.

3/ Information on air quality and the mines is from Joseph D. Coons, Consulting Engineer, San Rafael, California. Arizona Mining Congress is a client of Mr. Coons.

4/ Information pertaining to Miami Copper Company was obtained from James P. Pound, Director, Industrial Relations, Miami Copper Company.

5/ Information pertaining to Magma Copper Company was obtained from T. G. Chilton, Assistant to the President, Magma Copper Co.

6/ Information pertaining to Kennecott's Ray Mines Division was obtained from I. G. Pickering, General Manager.

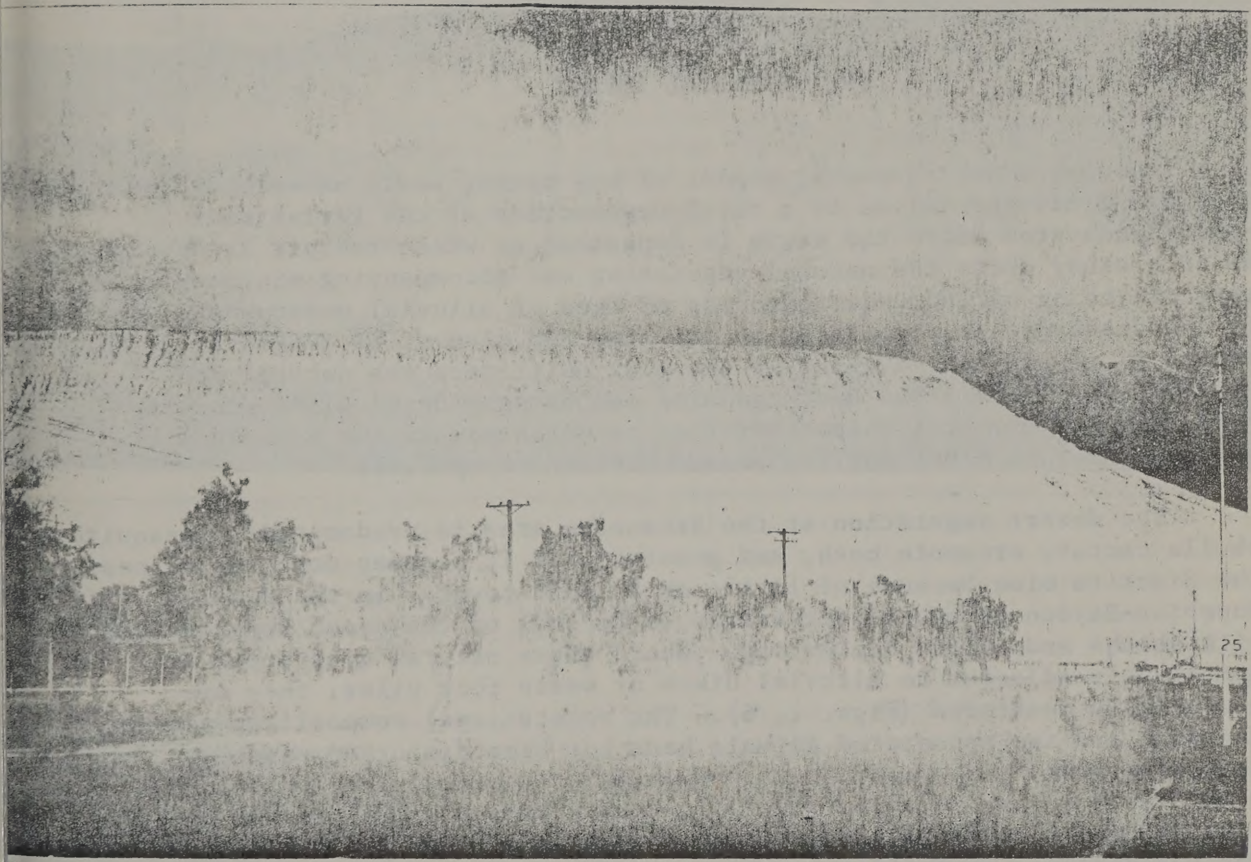


Fig. 5. Large cliff of tailings from old tailings deposits, downtown Miami, Arizona.

The mine is located 20 miles north of Hayden on Mineral Creek. At this location ore is mined and partially milled to be shipped to Hayden for concentrating and smelting. The mining operations create massive amounts of waste rock and the milling process and leaching which have started recently add iron oxides to the creek. At Hayden, disposal of tailings and slag create problems. The tailings are easily blown. Since the location of the tailings pond is in the middle of the valley, there are no natural topographic boundaries to hold the tailings and all containing dikes are constructed from tailings material. Slag is put in piles near the smelters, as at other locations, because it cannot be transported as slurry in pipes to distant waste locations.

ENVIRONMENTAL IMPACT

The major environmental impact of the mining waste as well as the open pit mines themselves is a total destruction of the terrestrial desert ecosystem where the waste is deposited or where the pit is developed. In both study areas the natural vegetation and accompanying microenvironment are being buried under hundreds of feet of alluvial overburden, waste or low grade ore-bearing rock, or tailings and slag piles (Figs. 1, 3, 6). These, along with the digging of the pit, obliterate the natural ecosystem. The waste areas and mine pits can be considered a new ecosystem with new environmental characteristics to which plants and animals will have to adapt in order for the area to become repopulated.

The desert vegetation at the Sahaurita area is predominantly mesquite, cholla cactus, creosote bush, and grasses; but it becomes more sparse near the Sierrita mine because of little or no soil cover. In the Miami-Superior-Hayden areas the vegetation is typical of the upper Sonoran Desert with shrubs and cactus dominating. Where these natural ecosystems are immediately adjacent to alluvial dikes or waste rock piles, they are essentially unaltered (Figs. 1, 6). The vegetational composition remains the same and the associated animals have not been disturbed enough to leave the area.

Because the waste piles often are placed in valleys to utilize the natural drainage to collect leach water, the topography of the areas is being and has been changed. The waste rock piles are high enough (Fig. 3) to change wind patterns and this might have a slightly detrimental effect on local vegetation, but observations do not show any dramatic effect.

Air quality has been a major issue especially in metropolitan areas where smelter emissions are blamed primarily for the increasing smog accumulation. Copper mining companies presently are being sued because of their lack of control of air pollutants, especially particulate matter and sulfur dioxide (Appendix V). It is questionable how much of the air pollution in Phoenix and Tucson is due to copper smelters and how much originates within the cities and their immediate surroundings (2). Studies have shown that the sulfur dioxide levels in the air between Hayden and Phoenix drop to near zero and then rise again in Phoenix (6).

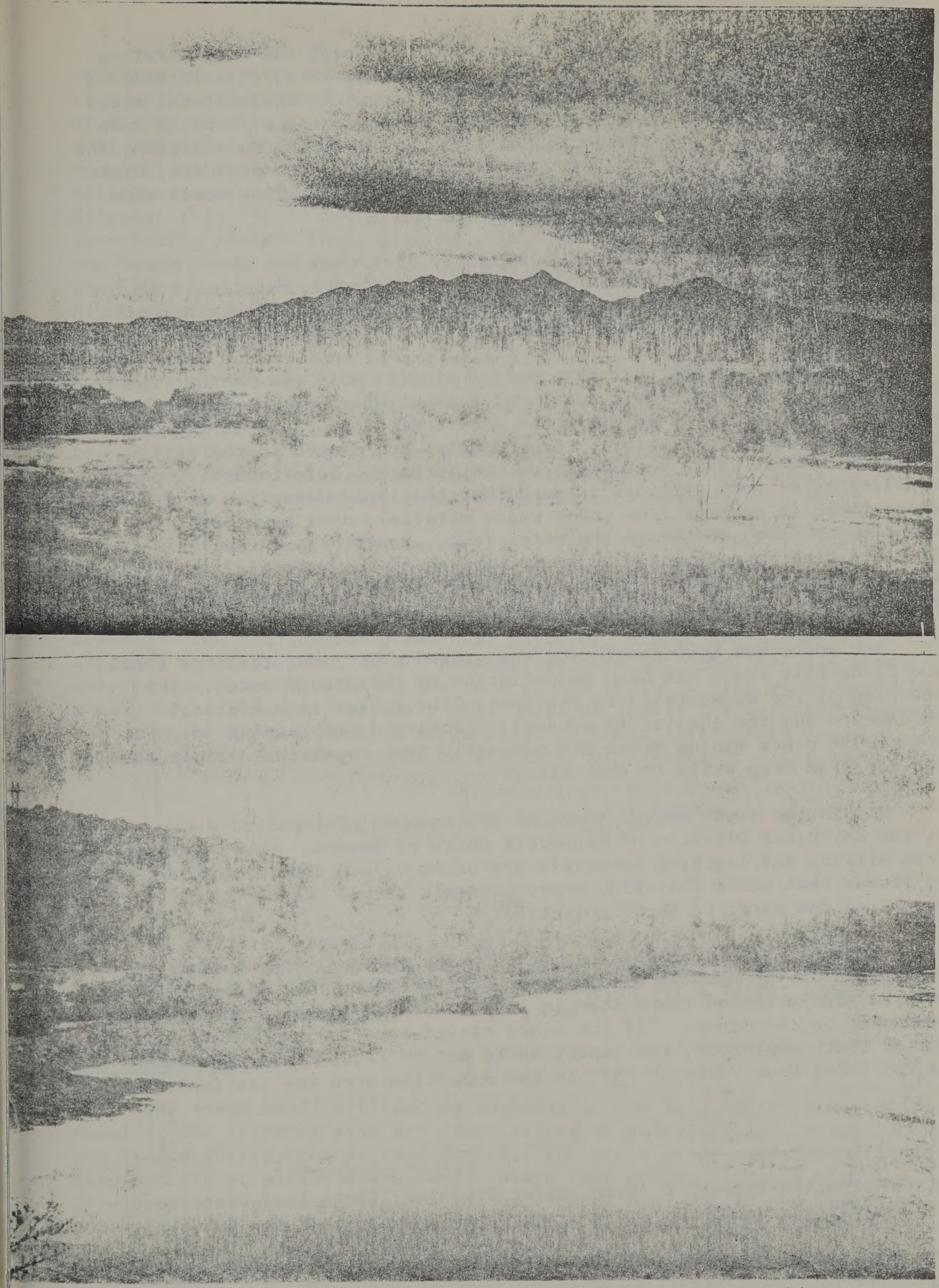


Fig. 6. Tailings burying desert vegetation. Top: Duval's Esperanza Mine (Santa Rita Mountains in background); bottom: Miami Copper Company's Copper Cities Mine.

Dust from the tailings piles and from the mining and concentrating processes often causes local complaints from housewives, even in company towns. This dust is not much more than that found in agricultural areas or in the desert when the wind blows, but its common occurrence in towns creates discomforts and should be considered pollution. In addition, the chemical composition of the dust, as well as other waste products, might be damaging to plants and wildlife. Only long-term studies would show this effect.

Water quality has been only slightly disturbed but there are fears that water quantity will be drastically reduced, especially in the Santa Cruz Valley near Sahaurita, as Duval and Anaconda increase their water demands and pump greater quantities of ground water (Appendix III).

In those smelters that have sulfur dioxide acid plants that remove the gas and produce sulfuric acid, water is utilized as the scrubbing agent. The scarcity of water in the desert dictates reuse of as much recoverable water as possible. Siphon pumps are placed in the tailings ponds to recover water that forms on the surface. Unfortunately, the consistency of most tailings is such that they hold water for many years. Where there is seepage from under waste material, dams have been constructed to catch and reuse the water (e.g., Superior). At Duval's Sierrita Mine approximately 70 to 80 percent of the water is recirculated. Water is lost by evaporation when a process requires heat and steam is produced (e.g., smelting), or when there is natural seepage into the ground.

The state has been monitoring the ground water near tailings ponds and finds that there has been no pollution of the ground water. The lowering of the water table in the Santa Cruz Valley is a cyclical phenomenon and the aquifer is generally recharged each spring 7/. Water sources at other mining areas are generally from mountain wells or streams and not from deep wells in the valleys.

Within the study region there is one example of impaired water quality, at the Ray Mines Division of Kennecott north of Hayden. Here, iron oxides from milling and leaching materials are often washed down Mineral Creek by floods that occur following heavy mountain rains. Kennecott is tunneling the water to avoid pollution.

A major impact, at least as it concerns regional communities, is the disruption of the natural scenic beauty of the area. This is criticized less in mine-oriented towns than in areas where the local economy is not dependent on the mines. "If the mines closed tomorrow and pulled out all of their employees, the impact would not be fatal on any community in the Santa Cruz Valley." 8/ In the Sahaurita area the residents look

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7/ Information from F. C. Ryan, Water Division, State Land Department, Phoenix, Arizona.

8/ Letter from Steve Emerine (see footnote 2).

on extensive cliffs of alluvial dikes (Fig. 1) which block part of the view of the Sierrita Mountains to the west, in contrast to an open view of the Santa Rita Mountains to the east. These dikes, if left barren, will not match the appearance of the surrounding mountains either in vegetational cover or topography. In the Miami area, large cliffs of tailings remain from the early days of exploitation and expedient waste disposal (Fig. 5). New dikes and tailings deposits are developing in the surrounding areas. These also have the potential of being eyesores. In the Hayden area the slag piles and tailings of ASARCO are deposited above the towns but the tailings pond of Kennecott is located in the Gila River flood plain immediately adjacent to State Route 177.

The major argument of citizens living near the mines against mine development, especially in the Sahaurita area, is in relation to scenic resources (Appendix I). During the early stages of the development of the waste deposits, there appear to be grounds for the people's fears unless something is done. The Globe-Miami area has tailings and slag piles that have been abandoned for more than 35 years (Old Dominion Mine (3)) with no natural vegetational establishment and massive erosion.

One other impact that is not truly environmental, but is due to environmental changes, is the removal of mining and waste deposit areas from any other use while the mining operation continues. One area near Sahaurita was used for cattle grazing before being leased for waste deposit. The mountainous areas near Superior, Miami, and Hayden could be used for recreation but in all probability were not used that way when they became patented land at the turn of the century. The waste deposit areas, if left barren, probably will never be usable for any other purpose; but if there is some form of reclamation on these areas, such as establishment of vegetation, they might be utilized for grazing or light construction.

PRECIPITATION OF THE PROBLEM

Land Use

The two study areas are a combination of federal, state, and private lands. Although this study is mostly directed toward federal lands, the total use picture should be presented for a better understanding of the situation.

(1) Sahaurita Area

The areas being utilized by Anaconda at the Twin Buttes Mine and by Duval at the Sierrita mine are combinations of patented land, state land, and land acquired from private owners. The areas being used for tailings deposits are primarily state land. State land policy dictates that the developer must prove mineralization or lack of mineralization, depending on whether the use is to be mining or waste disposal. 9/ If for waste

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9/ Information on state land policy was obtained from O. M. Lassen, Commissioner, State Land Department, Phoenix, Arizona.

disposal, once a lack of mineralization is proven the developer leases the land for a period of time at a per acre cost ($32.50/acre/year for ten years in this area). In addition, if there were grazing rights on the land, the mining developer would have to buy these from the rancher or wait for them to expire before applying for a lease. A new lease may be drawn up after the lease period expires. Similar agreements are reached if the land were to be used for mining.

The state controls the safety of the mines through State Mine Safety Laws and inspections but has no written agreement on stabilization of tailings or waste areas. The mining companies do have a general understanding, but not a written agreement, with the State Land Commission that the mines will try to revegetate and stabilize the fronts of the alluvial dikes and the surface of future abandoned tailings ponds. The only other state environmental control requirement of the mining companies is that some natural drainage areas from the mountains through or around the tailings ponds be left open. As mentioned earlier, the state does check for possible ground water pollution from the tailings ponds but has found none. Federal land policy is discussed in the following section.

(2) Miami-Superior-Hayden Areas

Most of the mining land in this area is privately owned, having been acquired through federal mineral patents under the Mining Law of 1872 ($5.00/acre for lode mines, $2.50/acre for placer mines). In order for an individual (or company) to apply for a mineral patent, he must prove commercial mineralization on the land, nothing else. 10/ If there are no encumbrances on the land, the federal government, through the Bureau of Land Management of the Department of Interior, must grant the mineral patent. Encumbrances may include other mining claims or leaseable minerals such as oil and gas, Neither the patent application nor the mineral patent requires protection of the environment, studies on the potential impact on the environment, or anything relating the mining with the ecology of the area. In other words, under the present mining laws, once the federal government relinquishes control of an area through mineral patents, it has no direct control of the environmental impact of mining on that particular piece of land. The federal government can create laws that control air and water quality in the regions in which the patented land is located or could affect land use indirectly, such as by boycotting copper purchases from a company that completely disregards environmental quality.

Early mining customs on patented land more or less disregarded the impact of the mining process on the surrounding ecosystem. Whole hillsides were cleared of timber for use in the smelting process and waste was dumped in the most accessible location (3). These "customs" have led to some of the problems in the Miami area which have opened the eyes of the mining companies, only recently, to possible abatement of the problems of waste control and reclamation.

10/ Information pertaining to federal land laws was obtained from Hall F. Susie, Chief, Branch of Minerals, Bureau of Land Management, Phoenix, Arizona.

Public Interests

The problems of mining and its waste disposal or reclamation relate to the public's needs for metalic products. Most of this country's economy is directly or indirectly connected with metals, and thus mining. In 1968 the value of copper produced in Arizona equaled about one-third of the total value of manufacturing production in the state. 11/ The public's interest has been shown to favor a cleaner environment and maintenance of scenic and recreational resources. Any change in mining laws should recognize the need to prevent further deterioration of the environment. However, the fact that mining technology now allows 0.35% copper ore to be mined economically, is a form of conservation of natural resources practiced by the mining companies. A balance between the destruction of one ecosystem by mining, establishing a new ecosystem on waste material to replace it, and the maintenance of present ecosystems must be created.

CONSIDERATIONS OF ENVIRONMENTAL IMPACT

The major consideration of environmental impact, at present, is by the State Land Department and the mining companies. The state has an agreement with some mining companies for reclamation (often referred to as restoration) of alluvial dikes (explained earlier). On the other hand, the mining companies have taken it on themselves to stabilize and revegetate, or "beautify," some of the waste deposits they are creating. At Green Valley, Duval and Anaconda have made presentations to civic organizations to show what they are doing, or plan to do, at the mines and waste areas. Federal laws hardly take environmental impact into account. Once a mining company can justify a mineral patent, the Bureau of Land Management must grant it. In addition, federal law permits an individual or company to explore and make cuts on federal land without government approval. Irresponsible road building during exploration may occur on the public lands if cooperation in planning exploration roads between companies and governmental agencies is absent.

One case where there was no patented land or application pending was the withdrawal of 7½ square miles of land on Mount Hopkins south of Tucson for use as an astrophysics laboratory site for the Smithsonian Institution. 12/ Although the mining companies claimed there was mineralization in the area to be withdrawn, the fears of disturbance by mining were recognized and the whole parcel of land was withdrawn from mining with the exception of small mining claims already in existence. Here the federal government recognized the impact of mining on the ecosystem and withdrew the whole area requested, although the transcript of the hearings

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11/ Arizona Progress. Valley National Bank, Phoenix, Arizona.

12/ Transcript of the Public Hearing on Mount Hopkins Forest Service Withdrawal Application in Behalf of Smithsonian Institution. A 1548. City Council Chambers, New City Hall, Tucson, Arizona, May 22, 1968.

shows that the mining companies felt the impact did not warrant such a large withdrawal. The area was kept open to recreation where it would not disturb the laboratory.

Where the mining companies have realized the impact on the ecosystem and scenic resources, they have at their own expense and volition tried to beautify and stabilize the alluvial and/or tailings dikes as well as abandoned tailings ponds. This process has been one of long-term experimentation with soil, fertilizers, and exotic and native species of plants (5). Anaconda, with the aid of a staff agronomist, has been quite successful in revegetating alluvial dikes. 13/ In 1966, some of the early dikes formed from alluvial taken near the surface were planted with exotic and native grasses, shrubs and trees. It took about two years for the shrubs and trees to become well established, but now the dikes have as dense a vegetation cover as the surrounding desert (Fig. 7). Because of the sterile condition of the soil, the dikes built with alluvial from greater depths did not readily support new vegetation. Organic fertilizer was added to the top and face of each lift, consistent with methods used for dikes now under construction (Fig. 8). Trees and shrubs were planted, and grass seed was scattered on the fertilized dikes. Although watering was not used during the earlier plantings, eight months of periodic sprinkling, followed by periodic watering of the trees after the sprinkling treatment is stopped, has allowed a greater percentage of success on these slopes. Where vegetation has not germinated (Fig. 9), additional fertilizer and seed will be scattered on the surface of the dikes. In a few years, the alluvial dikes will appear well vegetated; the vegetation will not be entirely native. Already, wildlife has moved back into the newly vegetated areas using it for food and protective cover.

Another example of stabilization and reclamation of waste material can be found at Miami, Arizona, where Miami Copper Company has stabilized an abandoned tailings pond and is revegetating the fronts of new tailings dikes. An old tailings pond from Miami Copper Company's Solitude Mine was blowing dust, and attempts at keeping the surface moist had failed. In 1959, experiments with soil deposits on the surface of the abandoned pond proved partially successful. Starting with an area resembling new tailings ponds (Fig. 10), soil was borrowed from the surrounding hillside and spread three to six inches deep over the tailings. Four different seedings proved quite successful in the soil as compared to the barren tailings which are highly alkaline (Fig. 11). Trees have also been planted successfully in the soil which was taken at shallow depths and thus was not organically sterile. Grass cover is so dense that local ranchers would like to use the area for grazing. Success on the abandoned tailings encouraged an attempt at reclaiming the face of newly-developed dikes (formed from tailings) by soil cover prepared for seeding. No sprinkling

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13/ Information on revegetation of the alluvial dikes was partially obtained from Don Russell, Agronomist, Twin Buttes Mine, Anaconda Copper Corp.

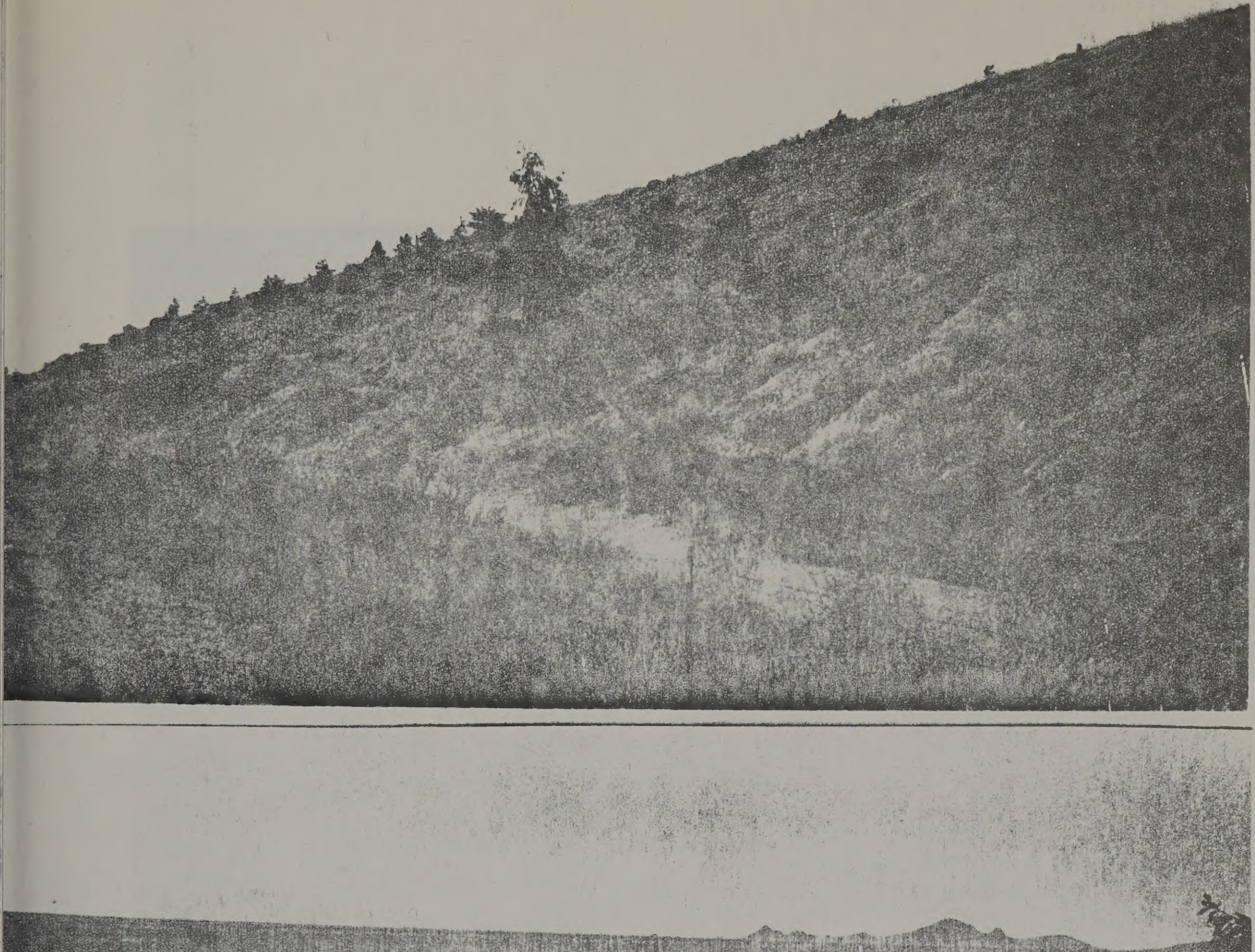

Fig. 7. Revegetation (1966) of alluvial dikes at Anaconda's Twin Buttes Mine.

Top: Facing edge.
Bottom: New Vegetation (foreground) compared to desert vegetation (background).

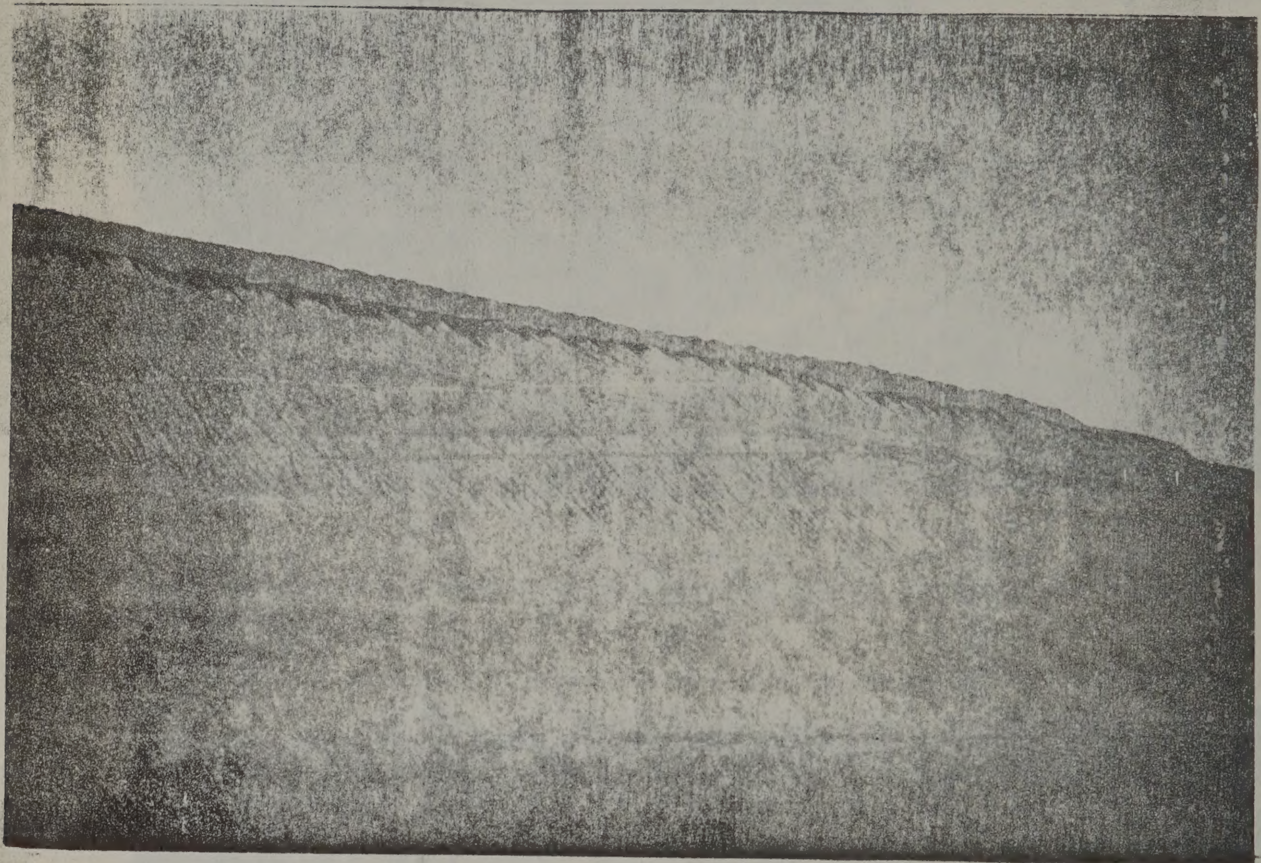

Fig. 8. New alluvial dikes at Anaconda's Twin Buttes Mine showing manure application (dark stain) near top.

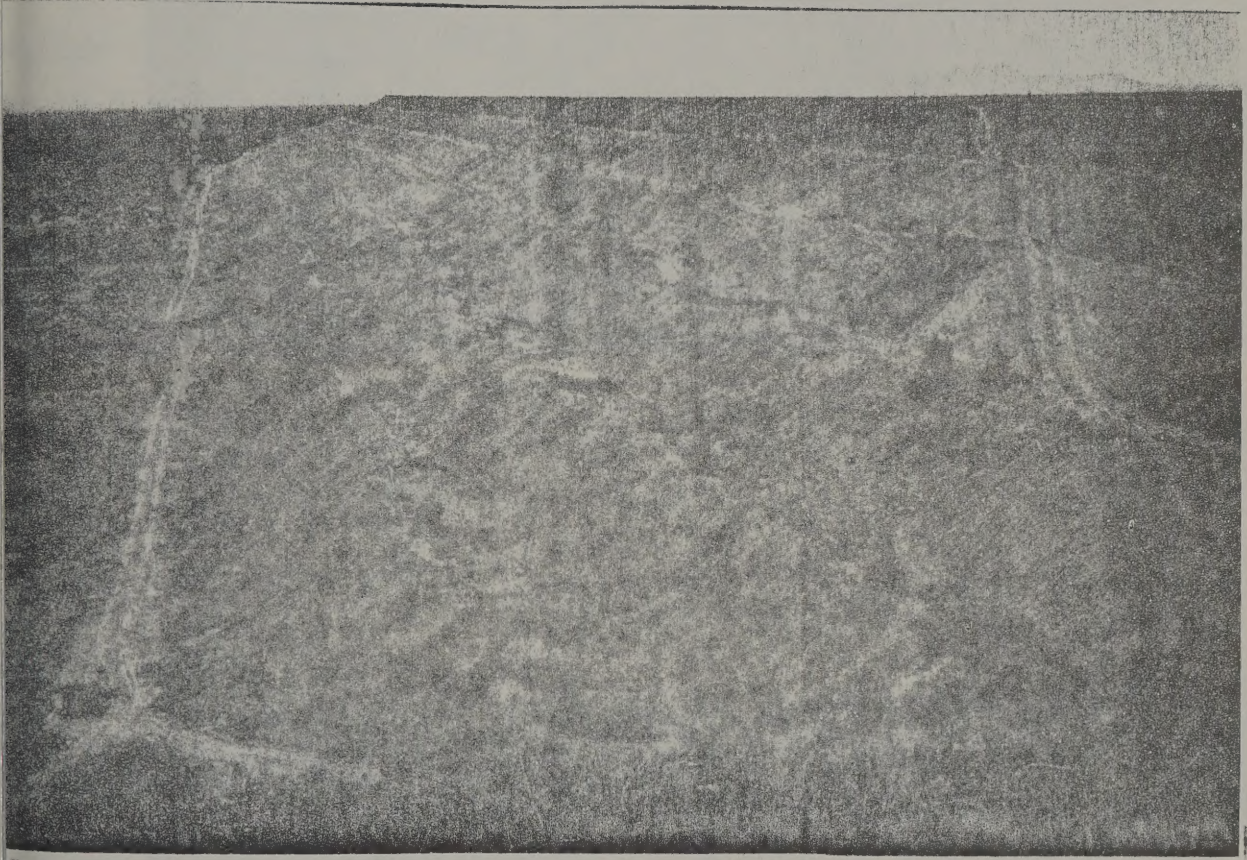

Fig. 9. Recent revegetation on alluvial dikes at Anaconda's Twin Buttes Mine. Spotty vegetation establishment will require additional seeding.

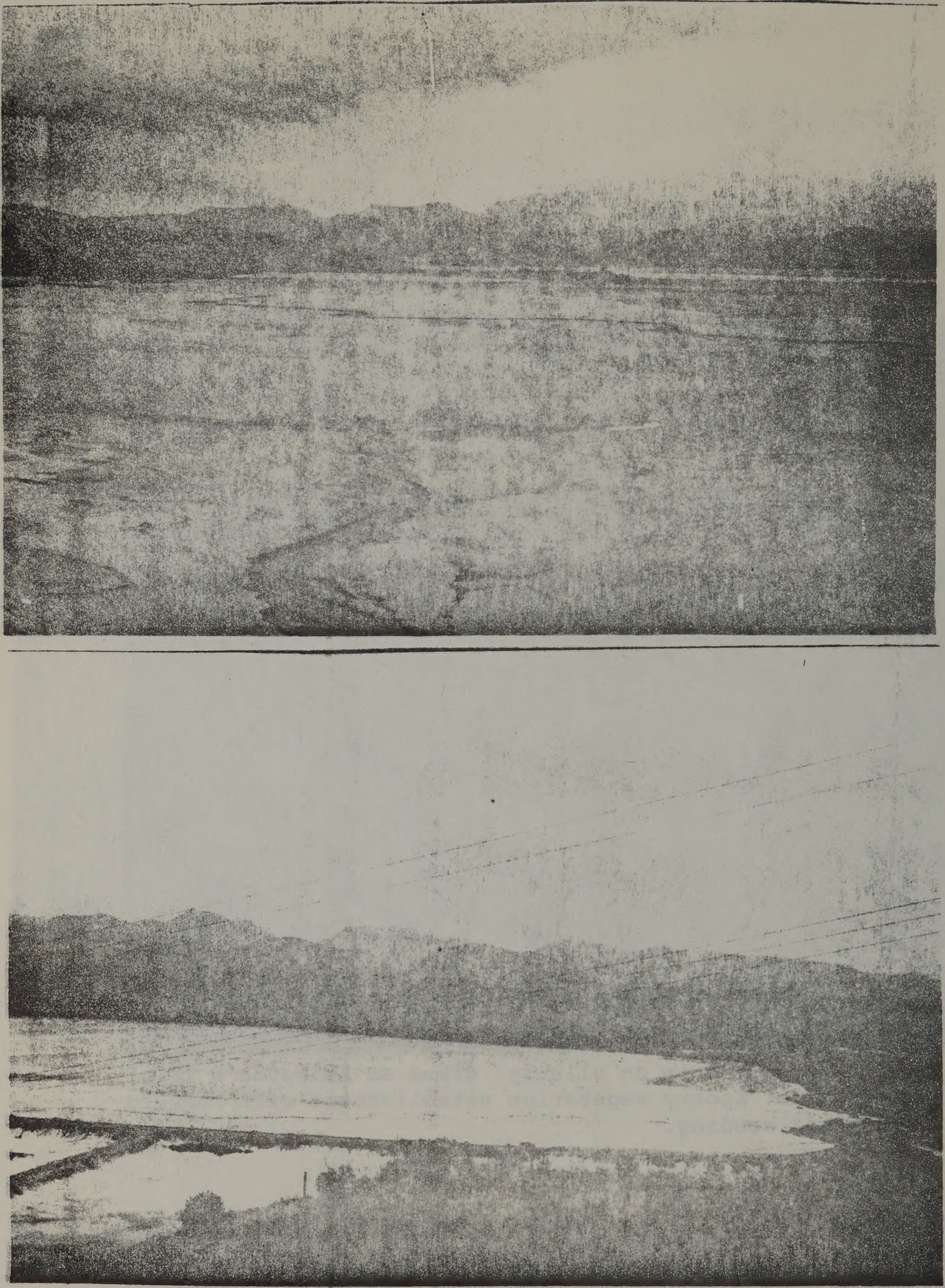

Fig. 10. New tailings pond at Miami Copper Company's Copper Cities Mine.
Top: Closeup
Bottom: Distance view showing terraced dikes containing the pond.

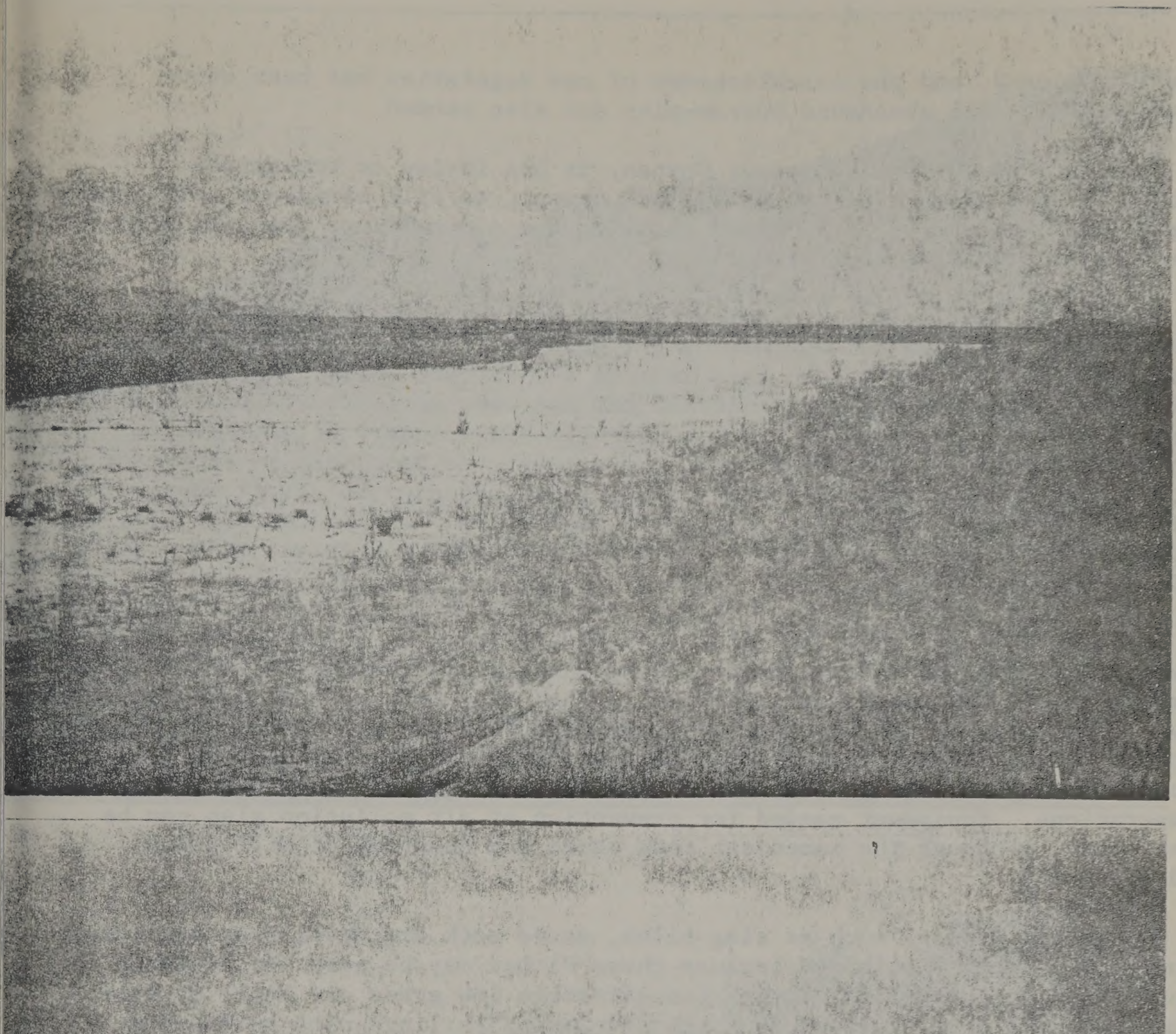

Fig. 11. Revegetation by seeding of abandoned tailings pond from Miami Copper Company's Solitude Mine.
Top: White area is pure tailings with no soil cover.
Bottom: Similar area as top picture but with a soil cover.

has been used, and the establishment of new vegetation has been quite successful. All abandoned borrow-pits are also seeded.

At Superior, Magma Copper Company is not trying to revegetate the tailings but uses them, mixed with cement, to fill mined-out units underground. Eventually, it is hoped, most of the old tailings deposits will be transferred back underground.

At Hayden, Kennecott Copper Company has problems with windblown tailings. They are reconstructing the tailings pond so that new tailings are poured in at all edges, thus keeping the surface moist. This technique is just in the development stage and has not been perfected. For esthetic purposes they are planting a row of Tamarix (Salt Cedar) between the highway and the tailings deposits. No attempt has been made by Kennecott to revegetate the sides of the tailings dikes because the desert mountains in the area do not provide enough soil to "borrow." Utilization of the only other source of soil would necessitate digging a deep pit in the Gila River flood plain.

These attempts at stabilization and reclamation, in some cases quite expensive, are the mining industry's approach to mitigating the environmental impact of their waste disposal. When they must go back to cover old abandoned waste piles, the cost ($250/acre at Miami) might be hard to justify to stockholders. However, present reclamation and stabilization costs can be absorbed into the total production cost or charged to current operations. Equipment needed for prevention of air pollution also can be absorbed, although the immediate cost would run hundreds of millions of dollars (2).

Other wastes, such as slag piles, waste rock and developing tailings ponds, cannot be reclaimed because these either may be used for leaching processes for copper extraction (on extremely low grade ore rock) or they may still be in a state of flux (as developing tailings pond surfaces or growing waste rock and slag piles). These waste areas will have to be considered in the future, and the ultimate decision will have to be made regarding abandoned open pits. The waste rock piles, similar in many ways to the natural rocky soils (Fig. 12), may gradually collect windblown soil and allow natural revegetation. At Superior where small areas of waste rock have been exposed for more than fifty years, no vegetation is yet established; but in a longer period of time (hundreds of years), or with man-introduced soil, vegetation should take hold. Slag piles will be an even greater problem. Slag contains much iron and silica and is quite sterile in encouraging plant growth. More than a few inches of soil cover are required for vegetational establishment.

ALTERNATIVES TO THE PRESENT MINING LAWS

Alternatives to present nonfuel mining laws have been thoroughly discussed in relation to the legal aspects of the law (4). None of this discussion relates to the environmental impact of mining. Early mining,

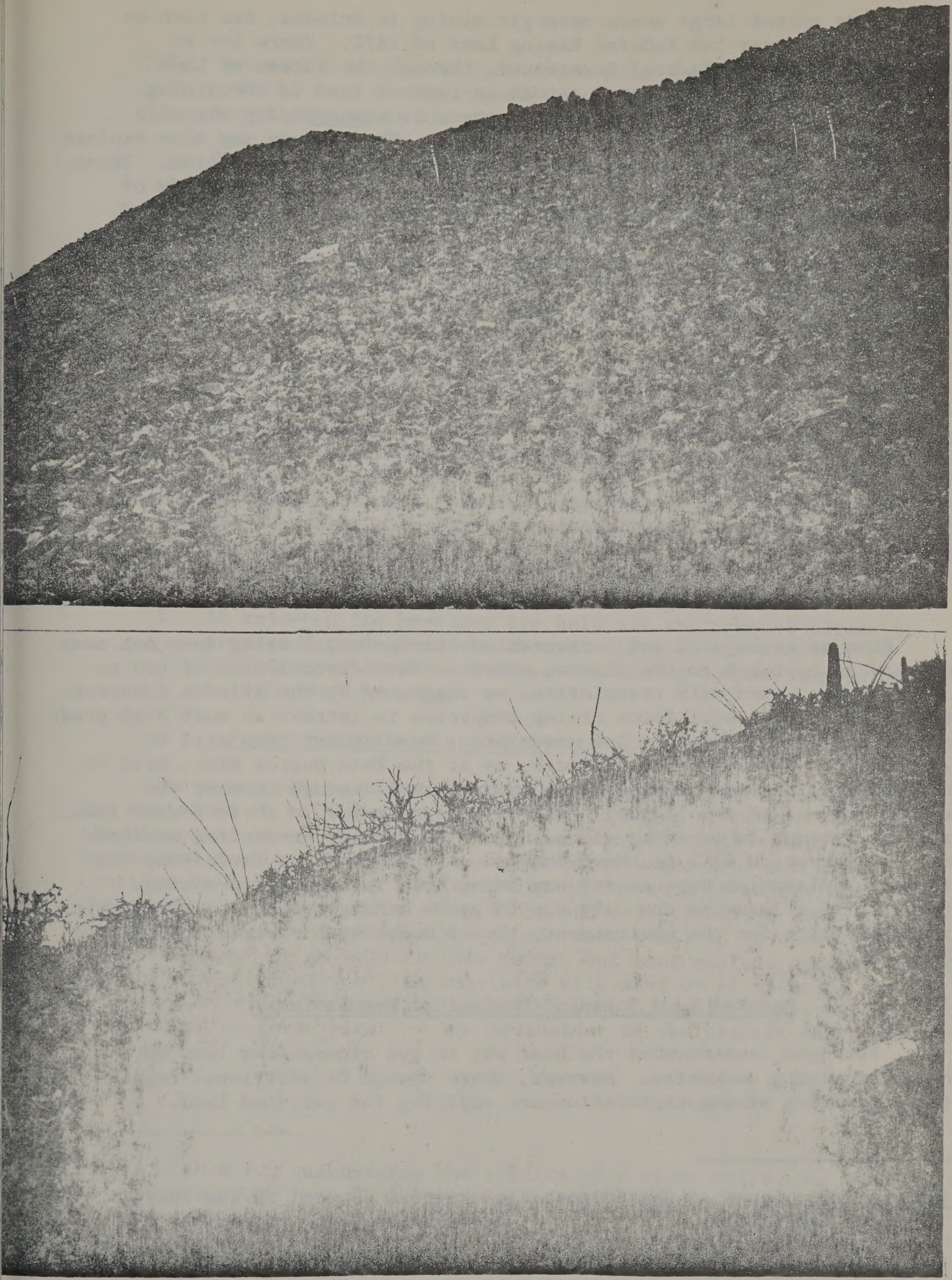

Fig. 12. Duval's Sierrita Mine.
Top: Waste Rock.
Bottom: Natural vegetation and rocky substrate.

as well as recent large scale open pit mining in Arizona, has been on land secured under the federal Mining Laws of 1872. There are no alternatives to the Federal Government, through the Bureau of Land Management, granting a mineral patent on federal land if the mining company (or an individual) has proven there is economically mineable ore, and the land has no other encumbrances. The company may also explore and disturb many acres of federal land without federal permission. There is no requirement that the mining company make an ecological study of its potential environmental impact and how this might best be reduced. There is no requirement for public hearings before the mineral patent is granted, although there is a waiting period between application and granting of the mineral patent. Essentially, the hands of the Federal Government are tied by the 1872 law.

State Land Policy

The state government, through leasing of land for periods of time, can write into the lease environmental restrictions; at the present time they think an oral agreement is satisfactory. The mining companies prefer the oral agreement; they feel it gives them more self-initiative toward reclamation, however, they ignore reclamation in areas not visible to the public.

Leasing in Relation to Ecology and Conservation

From an ecological and conservation standpoint, leasing does not seem as good an approach as the mineral patent. Short-term leases of ten to twenty years, even with restrictions as suggested by the Arizona Conservation Council 14/, will force mining companies to extract as much high grade ore as they can and ignore low grade ore. Development time will be speeded up and reclamation projects, as at the Twin Buttes Mine, will be hurried and inadequately done (but probably well enough to meet the specifications of the lease). Lessees have no pride in their leased land, and any attempt at creating an ecological balance or preventing environmental disruption will be short-changed even if it means forfeiting some form of reclamation bond as are now being used in coal strip-mining. However, if a lease is the only way to get a mining company to realize its responsibility for the environment, then a lease with restrictions should be used.

Federal Land Patents (Ecological Regulations)

Patented land remains the best way to put mineralized land in the hands of mining companies. However, there should be additional regulations covering mining exploration and applying for patented land.

14/ Position paper of the Arizona Conservation Council on the Public Land Law Review.

1. The public should be made aware that federal land may be granted to a mining company (or individual); hearings should be held prior to the granting of the mineral patent.

2. The mining company should have a qualified ecologist study the total environment (including wildlife) of the proposed mining area; this report should accompany the application for mineral patent.

3. The mining company should show how its mining and waste disposal operations are going to affect the environment, including impacts on scenic and recreational resources. This impact study should include: (a) the physical and chemical impact or influence of waste material and processing emissions on the surrounding vegetation and wildlife; (b) the potential disruption of the topography and its effects; and (c) a quantified estimation of the impact on esthetic values. 15/

4. The company should specify its plans for alleviating environmental impact. Such a plan might include soil covering and revegetation, but these may not be the only methods available for lessening the environmental impact.

5. If and when the hearings are held and the mineral patent is granted dependent on the acceptability of the proposal on environmental considerations, the mining company should be held to that proposal.

Present Self-Initiated Projects (Evaluation)

The revegetation and stabilization projects currently in progress (as explained in this report) are just a beginning of rehabilitation of the disturbed areas. Where soil is the basic substrate, planting of native and exotic species has been remarkably successful and should continue to be as long as the fertility of the soil is maintained. When the substrate is tailings or slag dumps and soil is only a superficial cover, the ultimate stabilization of the area still is in question. Plants have been shown to do well on this cover, but root systems appear shallow. Possibly the chemistry of the substrate will have to be altered, artificially or by time (hundreds of years), before a stable ecosystem can be established on these sites -- one equivalent to the natural surrounding vegetation.

15/ A method for quantifying the scenics of a river valley has been suggested by Luna B. Leopold. Landscape Esthetics, Natural History 78: 37-44. 1969, October.

CONCLUSION

The suggested alternatives to the present mining laws would place the initiative of reclamation in the hands of the mining companies, where they want it, and also permit the federal government to impose restrictions on environmental quality disruptions, including air, water and terrestrial environmental quality. These restrictions, not uncommon in purchasing land, which would be proposed by the mining companies would have to be acceptable to a federal commission in order for the mineral patent to be granted. Present restrictions requiring actual test holes to prove mineralization should be lifted because modern mining technology allows testing for minerals at great depths without any great disruption of the ecosystem.

If these suggested regulations had been part of the Mineral Laws when most of the land used for mining in Arizona was patented, those companies with mines in unpopulated areas would be practicing some sort of environmental quality control. Unfortunately, neither technology nor man's interest could keep the environment from being spoiled in the early days of Arizona mining.

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APPENDICES I - V

A series of newspaper clippings reporting on problems of copper pit mining in Arizona.

Green Valley
NEWS
combined with THE TUBAC BUGLE
Serving the Growing Santa Cruz Valley From Tucson to Nogales

49 GREEN VALLEY, PIMA COUNTY, ARIZONA PRICE 15 CENTS Dec. 26, 1968

GV Leaders Brief Senator Fannin

Welch Outlines Threat to GV From Mining

Since open-pit mining began in the Green Valley area four years ago, "problems are being created that could affect the continuance and growth of Green Valley."

That's what U.S. Sen. Paul Fannin was told here last week by Tom Welch, president of CRAGV, who added: "Tucson is beginning to look like Los Angeles did 25 years ago. Look at Los Angeles today."

Welch asserted that mining in the Santa Cruz Valley is producing large amounts of air pollution, is depleting groundwater, and is transforming the Arizona landscape "from a beautiful valley to dikes and mine tailings."

Fannin did not respond directly, except to note that mining developments are begun only after "a great deal of study" by both the mines and the Government.

Welch noted that many Valley residents came here for respiratory ailments, and that the mines' contribution of dust and smog is shortening their lives.

"We must keep clean air," he said. "Mining is important to Arizona, but I think people are more important."

Welch pointed out that Duval's huge Sierrita mine is being dug with an $84 million subsidy provided through a program of the U.S. General Services Administration. "So the maddening part of it is, that I'm being forced to breathe polluted air--which my own tax money helped bring about," he said.

Welch and others at the meeting expressed dismay at the amounts of water being consumed by Duval and Anaconda for their mines. "Already the groundwater shows a sizable

(Continued on page 6)

(Continued from page 1)

drop," Welch said. "Think what will happen when Duval gets to pumping in earnest; why, they'll suck this valley dry!"

The CRAGV president said progress on Anaconda's much-publicized effort to "beautify" its huge pile of earth just north of Green Valley "hasn't kept pace with the development." Duval apparently has no such program, he noted.

Welch told Fannin that the Federal government should "greatly expand" the area surrounding the Smithsonian Observatory on Mt. Hopkins that is exempted from mining, should "stop promoting mining in the area by loaning money, as in the Duval case," and "before further mining is allowed in the area, investigation should be made as to its effect on air pollution, water supply and landscape appearance."

GREEN VALLEY NEWS   OCTOBER 16, 1969

Anaconda Admits Pollution Violation

The manager of Anaconda's Twin Buttes mine has admitted to county air pollution officials that his mine is violating air pollution ordinances by sending columns of black smoke into the skies almost daily.

R. D. Lynn made the admission in answer to a letter to the Anaconda Co. by William F. R. Griffith, county air pollution control director, who asked the company to comment on charges first made in the Sept. 18 Green Valley News.

In that issue, co-publisher Steve Emerine charged in his Valley Views column that Anaconda was burning waste material regularly in violation of air pollution regulations.

As a result, Griffith wrote Anaconda asking for comments.

Lynn denied the accusation, but conceded that Anaconda had conducted 13 fire drills using oil fires since Jan. 1. Griffith said he feels the drills were legal and the frequency of the exercises was reasonable.

"Anaconda does not permit the burning of trash at the Twin Buttes property," Lynn wrote Griffith. "This operation adopted a landfill policy in 1968, and to my knowledge the employees here have adhered to this method of disposal.

"However, our records disclose that during 1969 two fires were extinguished at our trash dumps," Lynn continued. "Whether they were man-made or spontaneous, we do not know."

Lynn said the smoke actually is coming from exhaust stacks on five electric power plants at Twin Buttes.

"Your staff has expressed concern and has inquired of our efforts to remedy this problem," the Anaconda official wrote. "I recognize the urgency of correcting this matter and our efforts should show a marked improvement soon."

The five generator units are being tested and adjusted, Lynn said. Although Anaconda plans to operate them on pollution-free natural gas, the power plants thus far have been run on diesel fuel, he added.

Griffith said his office has "had some very definite complaints ...quite a few" from residents in Green Valley and other Santa Cruz Valley areas about the Anaconda smoke.

He termed the smoke "quite a serious problem, probably."

"Anything that is a constant source of black smoke like that is a problem, not only from putting it into the air, but to people in the area being restricted as to what they can do," Griffith added.

10-16-69

Green Valley
NEWS
Sep. 26, 1968

nta Cruz Valley Water ble Falls As Mines Step p Pumping

r Pits' Usage May Hurt Tucson

By STEVE EMERINE
Co-Publisher

evelopment of the Cz Valley may be ompletely--and the T son also will suffer--lt of large-scale tap- e underground Santa ey water supply by rations, the News was ek.

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ucson water engineer, that his name not be had this to say:

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y officials) have met mining people and is to their attention, pparently are going to regardless of the consequences to the rest of the val- said. "Especially Du-

"The new Duval operation will cut Tucson off from much of its water from the Santa Cruz Valley, but we'll still be able to get some water from the east for our Santa Cruz Valley wells."

"Farmers Investment can't get that water because its wells are cut off by the Santa Rita Mountains on the east," the Tucsonian said.

"If you think the water table has been affected now, wait until the mines really start pumping full-scale," he added.

The Tucson man revealed that at one of the city's meetings with mine officials, it was suggested that sewage effluent be used for mining operations instead of new water.

"Unfortunately," he said, "the city has a contract which runs until 1975 for its sewage effluent. The mines didn't think they could wait that long."

Asked what he thought the pumping of Santa Cruz Valley water in large quantities by Duval and other mining firms would do to development in the valley, the Tucson water authority said:

"There just won't be anything but mines. This will hurt Green Valley and other towns in the valley very badly."

Walden Says Some Wells 'Virtually Dry'

By TED TURPIN
Co-Publisher

The underground water supply for the entire north end of the Santa Cruz Valley appears seriously threatened by huge open pit copper mining developments in this area.

Early water-pumping efforts by the major mining companies here indicate that Duval, Anaconda and other copper giants may consume millions of gallons that would otherwise go for agricultural and residential use.

One of the first indications came more than a month ago, when Duval Corp. began test pumping from a newly-drilled deep well, located on the former Canoa Ranch. Duval quietly purchased major portions of the ranch south of Green Valley earlier this year.

Keith Walden, president of Farmers Investment Co. at Continental, reported that when Duval began pumping from the Canoa Ranch well, "the water level of our main irrigation well here at Continental dropped four feet within 24 hours."

In answer to a reporter's question, he said there's "absolutely no question" that such pumping will adversely affect the water table in the entire Continental-Green Valley area.

Duval officials announced in August that they expect to pump about 15,000 gallons of Santa Cruz Valley water per minute into their new mill at the Sierrita Mine southwest of Green Valley.

They said the test well was the first of six to be drilled on the former Canoa Ranch property. It brought in 7,200 gallons of water during a 24-hour period; Duval engineers estimate this can be increased to 3,500 gallons per minute.

Walden expressed concern over the long-range future of the Valley in view of the expected water consumption by the copper mines.

"We have seven wells along the Pima Mine Road that have virtually dried up during the last 30 days," he said.

Walden noted that Anaconda Co. has begun pumping from a newly-drilled 2,000-foot well--more than twice as deep as the FICO wells--during that approximate period.

"I guess we'll have to drill even deeper if we're to compete for water" he said. "But the big problem is, that it's all coming out of the same bathtub."

Hydrologists for years have kept an anxious eye on the groundwater table in the Tucson area. It drops steadily in most years, since more water is taken out of the ground than is returned to it through rainfall, snow runoff, and reclaiming of used water.

The Santa Cruz Valley is the trough which replenishes that Tucson basin.

GREEN VALLEY NEWS SEPT. 18, 1969

9-18-69

MAY DRILL OWN WELL

Many Choices—All Expensive—In Sahuarita Village Water Crisis

Worried residents of Sahuarita Village are still investigating ways to get water—as wells in the area continue to go dry, or threaten to go dry.

Several avenues are open to them, the rural residents agreed at a neighborhood meeting last Friday. These avenues have one thing in common:

They are all expensive.

The cost of getting a reliable water supply will almost certainly exceed $10,000--and water company experts said that figure is conservative.

The 25 to 30 families involved live just west of Sahuarita. One group of homes and small farms is west of the Santa Cruz River and north of the Helmet Peak Road; the other group is just east of the river and south of the road.

Despite recent summer rains and the proximity to the Santa Cruz River, all of their wells have reflected a falling groundwater table in recent weeks.

Some of these, 200 feet deep or less, have gone dry. Other, deeper, wells have experienced difficulty.

What to do? A committee of homeowners is considering these choices:

—Find out if the afflicted area lies within the "service area" of someone holding a water company certificate from the Arizona Corporation Commission.

(ACC representative Earl Seels, who attended the Friday meeting, said he wasn't sure whether it does or not. If so, he said, the certificate probably belongs to Farmers Investment Co. at Continental, or rancher Frank Appleton.)

--If the afflicted community does lie in a certificate area, see if the authorized water company will sell water to the homes and a trailer court on Sahuarita Road owned by W. E. Whiteley.

--If it will, investigate the cost. (Arizona Water Company representatives at the meeting said getting water to the two portions of the scattered community would be "very costly.")

--If that fails, petition Anaconda Co. to serve the community from its new 2,500-foot well near the Twin Buttes mine.

--If Anaconda refuses, try to form a cooperative water company, with each family contributing to the initial cost of putting down a well that would serve the community.

--Seek financial aid from the Farmers Home Administration, a federal agency which rural anti-poverty worker John Arnold said is willing to help.

* * *

* * *

'Who's To Blame?' Ask Water Shortage Victims

Who's to blame for the falling water table in the northern Santa Cruz Valley?

That question was asked several times Friday evening at the emergency meeting of Sahuarita Village residents.

"It's the mines," said one attractive redhaired woman. "Who else?"

"The mines claim it's Farmers Investment Co.," said another woman. "I asked them."

"Farmers Investment has been here for years, and the wells haven't gone dry," pointed out a beard-stubbled farmer.

The Anaconda people say those pecan trees take a lot more water than cotton did," responded the woman. "Ha," chimed in an older woman. "They don't take as much as cotton does."

The group, mostly Mexican-Americans, that gathered in the home of Phil Espino displayed little bitterness or antagonism--only a concern about their failing wells and a desire to find a solution.

John D. Arnold, a federal anti-poverty worker for rural areas, had consulted a hydrology expert about the falling water table. "Who did he say was to blame, John--FICO or the mines?" asked one resident.

"He said it was about half and half," Arnold replied.

Just how fast is the water level falling? Estimates vary --but there's no doubt that it is falling.

"Our Green Valley wells have dropped about six feet since 1965," said a man from Arizona Water Co.

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Phoenix, Fri., Jan. 2, 1970 The Arizona Republic 11

Globe not sure mines are sole cause of smog

By TED LAKE

GLOBE — Several prominent Globe-Miami residents have expressed mixed reactions on the controversy over copper smelter smoke and its relation to smog, along with the lawsuit filed by two college professors against four copper companies seeking $2 billion in alleged damages.

Dr. John N. Mrgudich of Globe a retired physical research scientist for the U.S. Army, said that, on the basis of information he has obtained from the Inspiration Consolidated Copper Co.'s stockholders' report, he estimates that the firm's smelter near Miami is pumping out what may be the equivalent of 550 tons of sulphuric acid each day.

Dr. Mrgudich said he feels the sulphur trioxide (SO3) white mist, which can be seen and which forms after the fumes leave the smelter stack, is more serious than sulphur dioxide (SO 2).

Mrgudich said that, if the copper companies can get rid of the SO 3 mist, "I think they've got their problem solved." He added that the health department monitoring stations should be watching SO 3 in the state instead of only SO 2.

One of the big arguments the copper mines are using, he said, "is that, sure, we can get the acid out but we can't do anything with it or get rid of it."

Dr. Mrgudich suggested that there are a number of companies in the state burning sawdust, which also contributes to air pollution, but he said that, if the sawdust were mixed with the acid, an organic fertilizer would result.

He said he is not sure whether the lawsuit filed by the two Arizona State University professors was the proper thing to do "but it seems to be the way to get some action."

Dr. A. M. Sanchez, Miami mayor, said he feels that the situation can be worked out with the copper companies in a diplomatic manner rather than through legal action.

More about

Globe smog reaction

Continued from Page 1

"I have always found the mines cooperative," he said. "I don't think there is any doubt that the mines are partially reponsible for some of this, but we can't condemn one industry for all of the air pollution. We all do our share of polluting the air with the automobile."

Nick Ragus of Miami, who is on the administration staff of the Miami Public Schools, said, "I like to see this smelter smoke. It means that kids can eat and go to school — and the mines are very essential to everybody."

Ragus said that copper smelters have been operating in the state for more than 40 years.

"How come that 40, 30, or 20 years ago they weren't complaining about smog and now they are blaming the copper companies for smog which has developed over the past several years," he asked. "I don't think clamping down on the smelters will solve the problem."

Ragus said that the metropolitan areas "should clean up their own backyards."

Mitch Vusksanovich, local businessman who lso is president of the Miami School Board, said there is "no doubt that the mines are putting out sulphur smoke but they are no doing all of the pollution."

"If you go down to the Valley," he said, "you can notice tremendous amounts of dust and smoke, which we don't have inthis area although we do have the sulphur smoke. Basically, we have been breathing sulphur smoke up here for years."

THE ARIZONA REPUBLIC

Tuesday, Dec. 30, 1969 ☒ ○ Page 25

Copper firms sued on smog

A lawsuit seeking $2 billion in damages due to air pollution was filed yesterday in Maricopa County Superior Court by two university professors against four of the state's major copper mining firms.

The suit, by Professors Mark Reader and Albert J. Mayer of Arizona State University, also asks the court to enjoin the mining firms from any further operations that "would allow the continued infusion of pollutant materials into the air . . ."

The action was filed by Phoenix attorney Richard B. Wilks on behalf of the ASU professors and their wives as a class action, representing all Maricopa County residents "who have occasion to and in fact do breathe air polluted by the defendants . . ."

Named as defendants were Magma-Superior Copper Co., an Arizona corporation, Inspiration Consolidated Copper Co., a Maine corporation, Ray Mines Division of Kennecott Copper Corp., a New York corporation, and American Smelting and Refining Co. (ASARCO), a New Jersey corporation.

The suit charges that the four defendants, operating copper smelters and "other industrial devices," knowingly have discharged into the atmosphere "toxic particulate matter" which is carried by natural air currents into the Salt River Valley.

The complaint further alleges that the defendants "have for many years been aware of the fact . . . that said particulate matter was toxic and caused respiratory and other physical ailments in human beings."

The defendants, according to the complaint, could have "eliminated or greatly reduced the quantity of pollutants emitted" by installing certain "technical devices" in their plants, but they "have negligently failed to do those things which would have prevented injury to the plaintiffs" and other Maricopa County residents.

Continued on Page 26

More about

Suit on smog filed

Continued from Page 25

The suit asks the court to assess actual damages plus $1 billion punitive damages for the "wanton and willful behavior of the defendants," and $1 billion for negligence.

Furthermore, the suit claims, there is a real danger that continued pollution from mine smelters "will permanently affect the plant and animal ecology of the Salt River Valley," forever changing its environment "and decreasing the possibility of successful human existence in said valley. . ."

Therefore, the plaintiffs assert, the court should restrain the defendants "by injunction from maintaining or using their copper smelters and other industrial devices . . . in such a way as to infuse into the air pollutant materials."

Reader, of 1158 Concorda Drive, Tempe, is a political science professor, and Mayer, of 4814 N. 72nd Way, Scottsdale, is a sociology professor.

Reader said he decided to take court action during the Valley's 11-day siege of smog that lifted Christmas Day.

"We hope through this action to compel the mines immediately to put in existing smog control devices or at least to desist operation when pollution becomes a menace to the public health and safety of the citizens of the Valley," Reader said.

He charged that "when this area was so polluted last week, the mines did not publicly take cognizance of the situation or do anything that we know of to stop fouling the air."

Reader conceded that automobiles and other pollution sources also contaminate the air. "I don't think any reasonable person would say the mines are the sole culprits," he said, but added:

"Public health officials say the major cause of sulphur dioxide pollution is the mines. When the mines were on strike you could see farther and breathe more freely. The mines do make a difference."

ASARCO and Kennecott operate copper smelters at Hayden, about 80 miles southeast of Phoenix. Magma's smelter is located at Superior, about 60 miles east, and Inspiration's operation is near Miami, 70 miles east of Phoenix.

CASE STUDY NO. VI

WESTERN UTAH GRAZING

by

DR. STANLEY L. WELSH
DR. JOSEPH MURDOCK
BOTANY DEPARTMENT
BRIGHAM YOUNG UNIVERSITY
PROVO, UTAH

Prepared Under a Contract With The
Rocky Mountain Center on Environment
Denver, Colorado

RECITATION OF FACTS

Wah Wah and Pine Valleys are located in western Millard and Beaver Counties, Utah in the southeastern portion of the Great Basin (Map 1). The two valleys are oriented north-south and are separated by the Wah Wah Mountains. The valleys average about fifty miles in length and ten to twenty miles in width. The combined area is about 1,440 square miles. About 1,240 square miles of land in the region is under Federal control. Of this total, eighty-seven square miles are included in the Forest Service Intermountain Forest and Range Experiment Station Desert Experimental Range (Map 2 , and about 1,153 square miles are controlled by the Bureau of Land Management. The remainder of the region is owned by the State of Utah, (170 square miles), or is in private ownership, (approximately 30 square miles). Land in the vicinity of Indian Peak designated as Indian Reservation has been purchased by the Utah State Fish and Game Board (8), and is included in the state lands total.

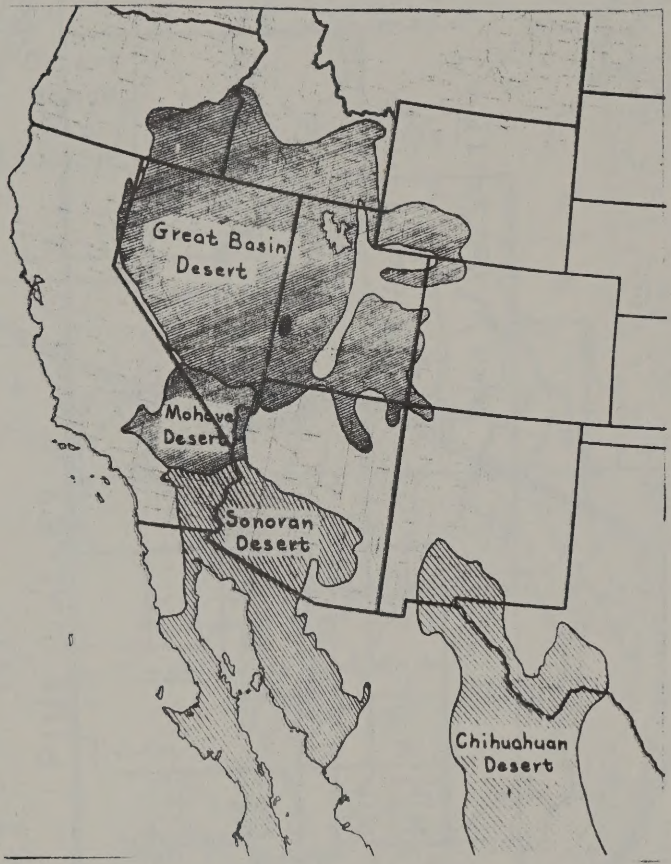
The climate of the region is marked by temperature extremes, scanty precipitation and strong, drying winds. In Central Pine Valley, the average annual precipitation over a twenty-four year period is only 6.10 inches (11). The mountains receive heavier amounts of precipitation and are snow-covered each year, but the valley bottoms are seldom snow-covered for more than a few days or weeks. Daily and seasonal fluctuations in temperature are typical, with extremes of 100°F in summer and -35°F in winter (19).

The few springs and streams are located in the mountains above the valley floors. Permanent streams are small and short, and sink before they reach the valley bottoms.

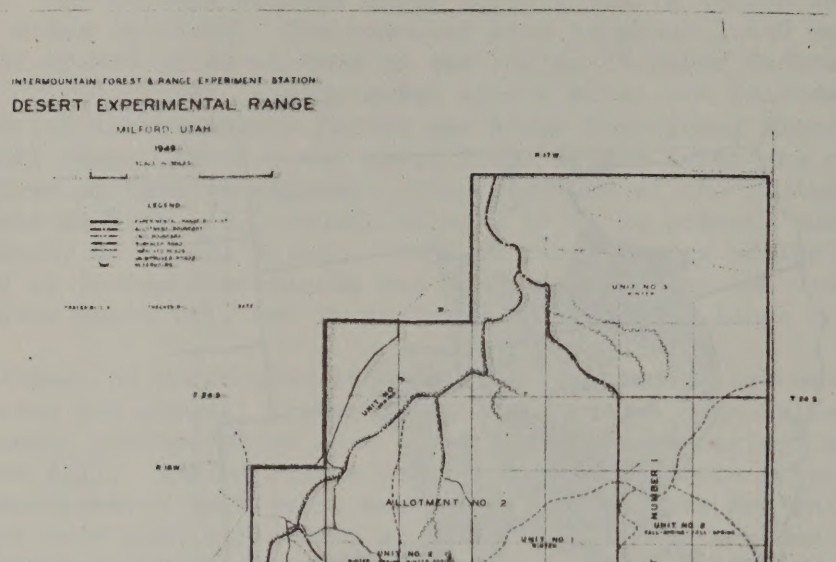
Vegetation is typical of the Northern Desert Shrub Biome. The valley bottoms are occupied by sparse shrub and shrub-grass vegetative types (Map 3). Major plant species are shadscale, winterfat, budsage, black sagebrush, big sagebrush, rabbitbrush, horsebrush, and grasses. At elevations above the shrub types and interfingering downward is the juniper-pinyon community. This is the most important woodland type covering thousands of acres in the foothills and mountains. Various grasses are abundant in the sub-types of this community. Scattered stands of Douglas-fir, white fir, bristlecone pine, ponderosa pine and aspen occur at higher elevations.

Onto this setting was impressed grazing of livestock. The attendant road building, fence construction, water development and other activities resulted in long-lasting changes in vegetation, scars on the landscape, soil erosion, and changes in water run-off.

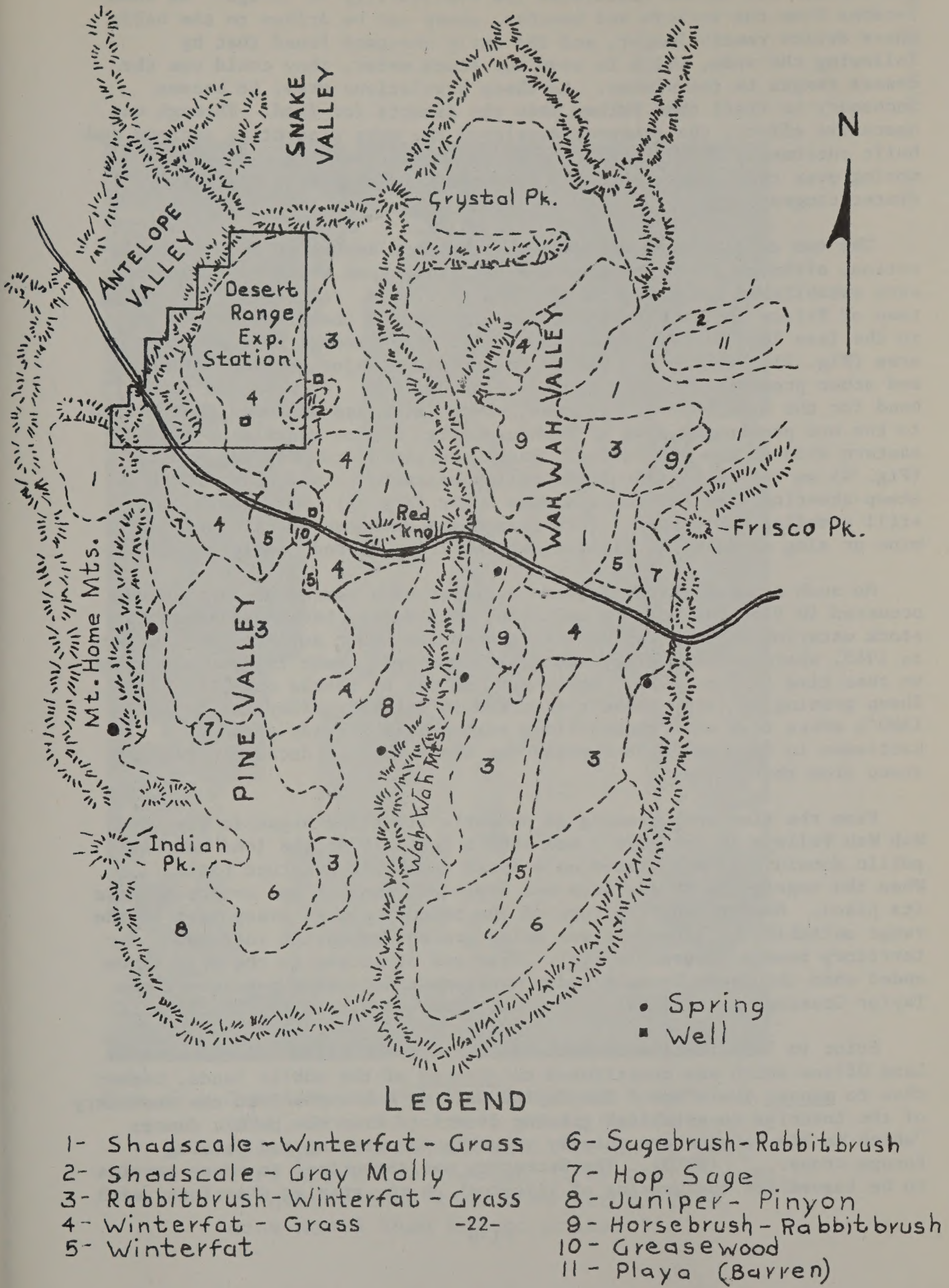
The major use of the region has been winter grazing of livestock, but some portions are utilized throughout the year and others only in the summer. The winter range is dry, for there are only a few, small, widely dispersed springs; but the twigs of dormant shrubs are palatable and nutritious, and the dry grasses provide energy. Light snow-cover provides water for



Map 1. Black dot indicates the location of the case study site with respect to arid lands.



Map 2. Intermountain Forest and Range Experiment Station. Desert Experimental Range. Pine Valley, Utah.



Map 3. Vegetation of Pine and Wah Wah Valleys (adapted from 30, p. 290)

the animals but seldom diminishes the availability of forage. As snow recedes from the valleys and benches, sheep can be driven to the hills where drifts remain longer, and the early sheepmen found that by following the snow, which is used for stock water, they could use the desert ranges in the winter. As sheep populations grew, it became necessary to trail them farther into the deserts for feed. Through cooperative effort, the sheepmen developed the more productive springs and built catchments for rainfall runoff to provide water for animals moving over the driveways to and from their increasingly distant winter ranges (10).

The two valleys have not received the same amount or type of utilization, although the vegetation was the basis upon which settlements were established and a way of life was developed. (Fig. 1) The mining town of Frisco in the Wah Wah Valley arose after the discovery of ore in the late 1800's, functioned and failed upon removal of the rich ores (Fig. 2). During its heyday Frisco was a major receiver of meat and other products from Wah Wah and Pine Valleys. It was also the rail head for the Utah Central Railroad, which later was extended from Frisco to the ore processing town of Newhouse (Fig. 3), on the slopes of the eastern side of Wah Wah Valley. Water was piped from Wah Wah Spring (Fig. 4) on the west side of the Valley eastward to Newhouse, where a sheep-shearing shed and corrals were built (Fig. 5). The sheds are still standing but unused. Both Frisco and Newhouse survive only as mine or slag dumps (Fig. 6), foundations (Fig. 3) and cemetery (Fig. 7).

No such concentration of human activity of a corresponding nature occurred in Pine Valley. In addition, Pine Valley had fewer adequate stock watering sites. Wah Wah was grazed for about seventy years prior to 1940, whereas Pine Valley was grazed for only about fifty years prior to that time (19, p. 292). Early grazing was by cattle only (19, 22). Sheep grazing in large numbers occurred in Wah Wah Valley in the late 1880's where they were grazed along with cattle already present. Cattlemen in Pine Valley succeeded for about another decade in keeping sheep from that valley.

From the time when grazing of domestic livestock began in Pine and Wah Wah Valleys in the 1870's and 1880's until 1934, the land was free public domain. It was grazed on a first come, first served basis. When the vegetation in one area was depleted, another was sought to take its place. However, by the turn of the century almost every part of the range suitable for livestock was being grazed; expansion into new territory became impossible (13). Free use of ranges in the arid lands ended when they were brought under management following passage of the Taylor Grazing Act of 1934. (48 Stat. 1269, 43 U.S.C. §§ 315-3150-1.)

Prior to 1934, the lands were under the jurisdiction of the General Land Office which was constituted to dispose of the public lands, rather than to manage their use. The Taylor Grazing Act authorized the Secretary of the Interior to establish grazing districts from the public domain "which in his opinion are chiefly valuable for grazing and raising forage crops..." (§315) The Secretary was authorized to cause permits to be issued for the grazing of livestock on the grazing districts, with

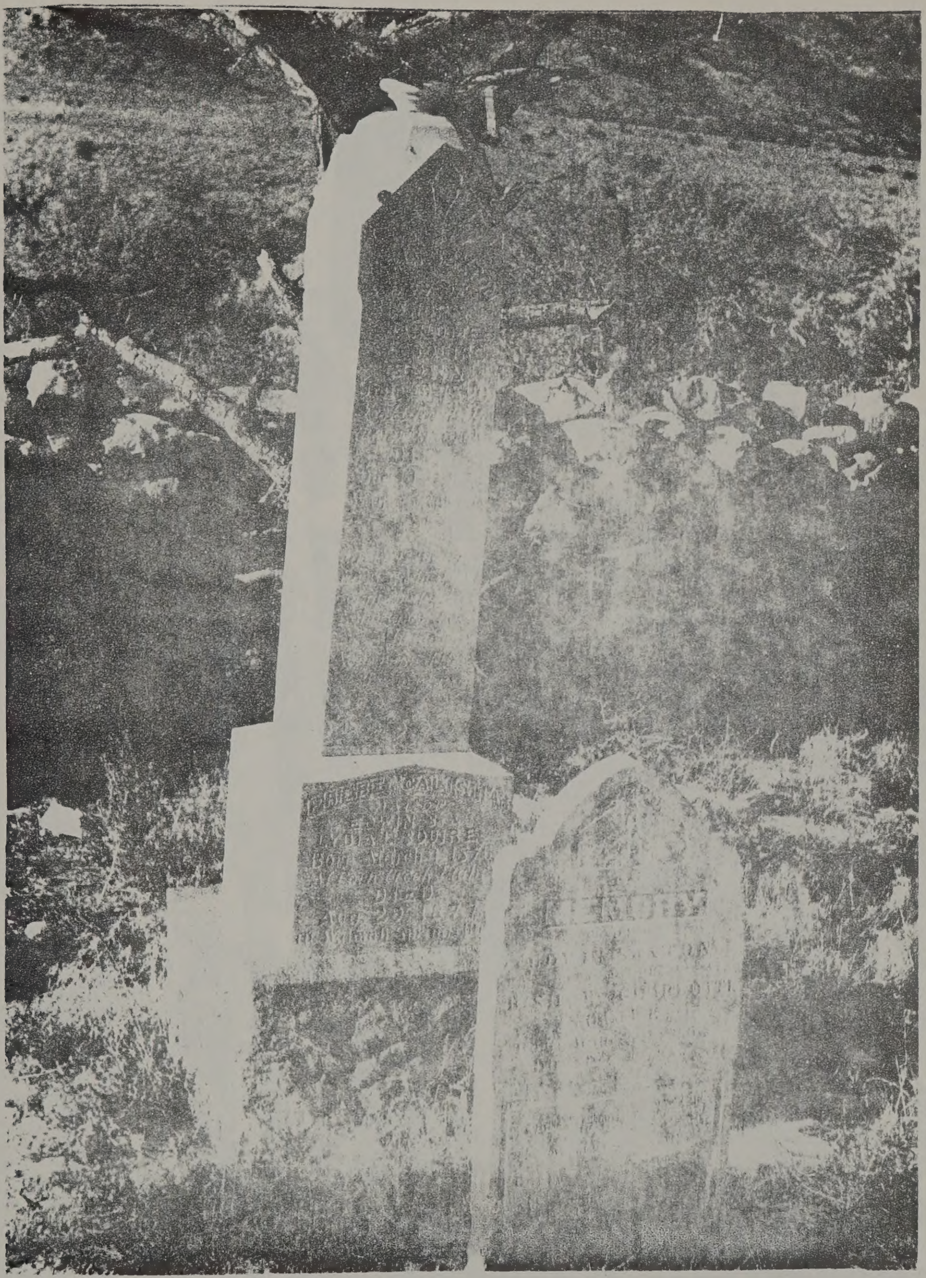


Fig. 1. Cemetary at Wah Wah Springs, Beaver Co. Utah, Dec. 13, 1969. Edwin Saxton Squire epitaph is significant: "Green is the turf above the husband of my better days, none knew thee knew thee but to love, none named thee but to praise."

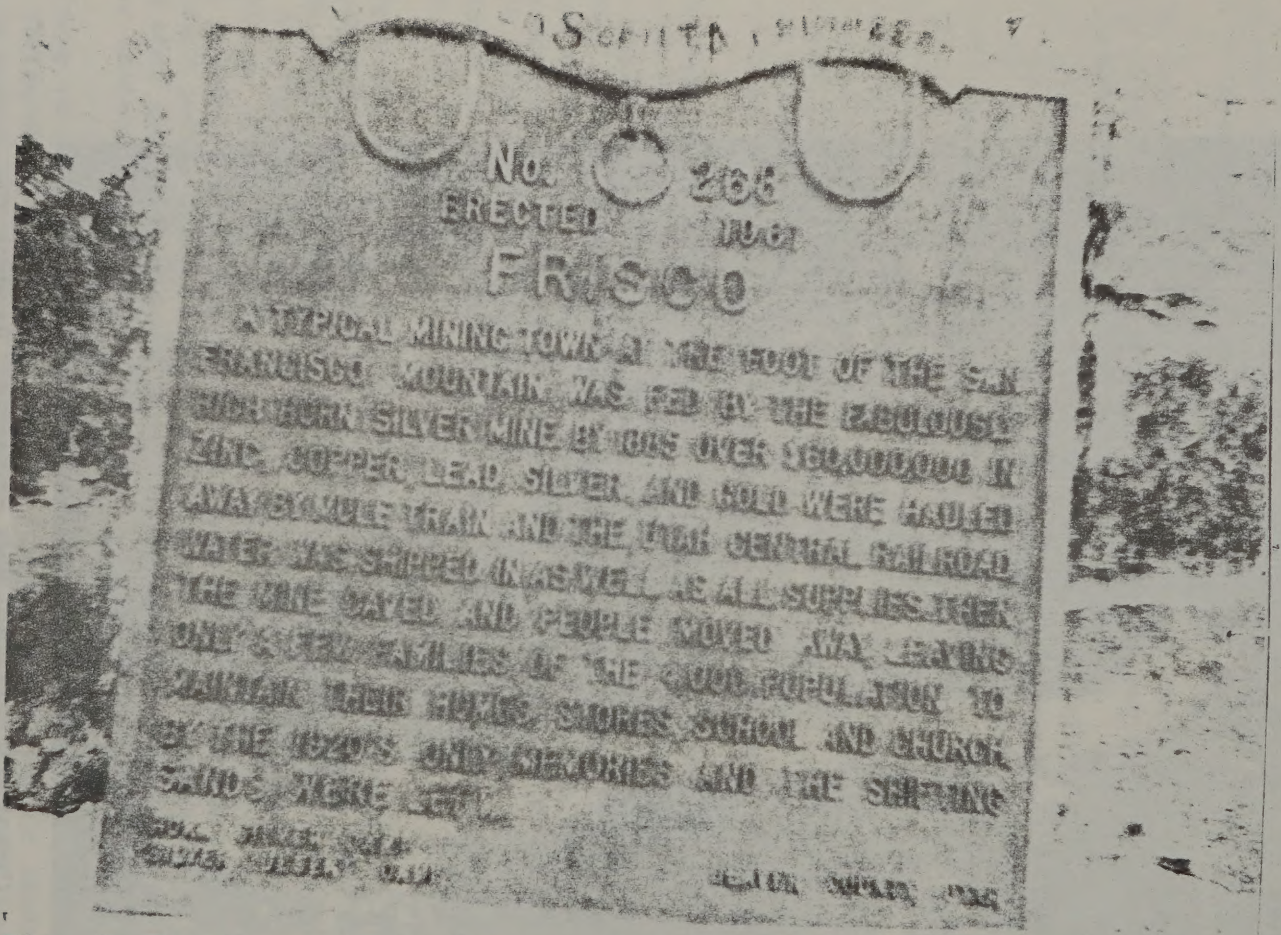


Fig. 2. Daughters of Utah Pioneers Monument at the old townsite of Frisco, Utah, Beaver County, Utah.

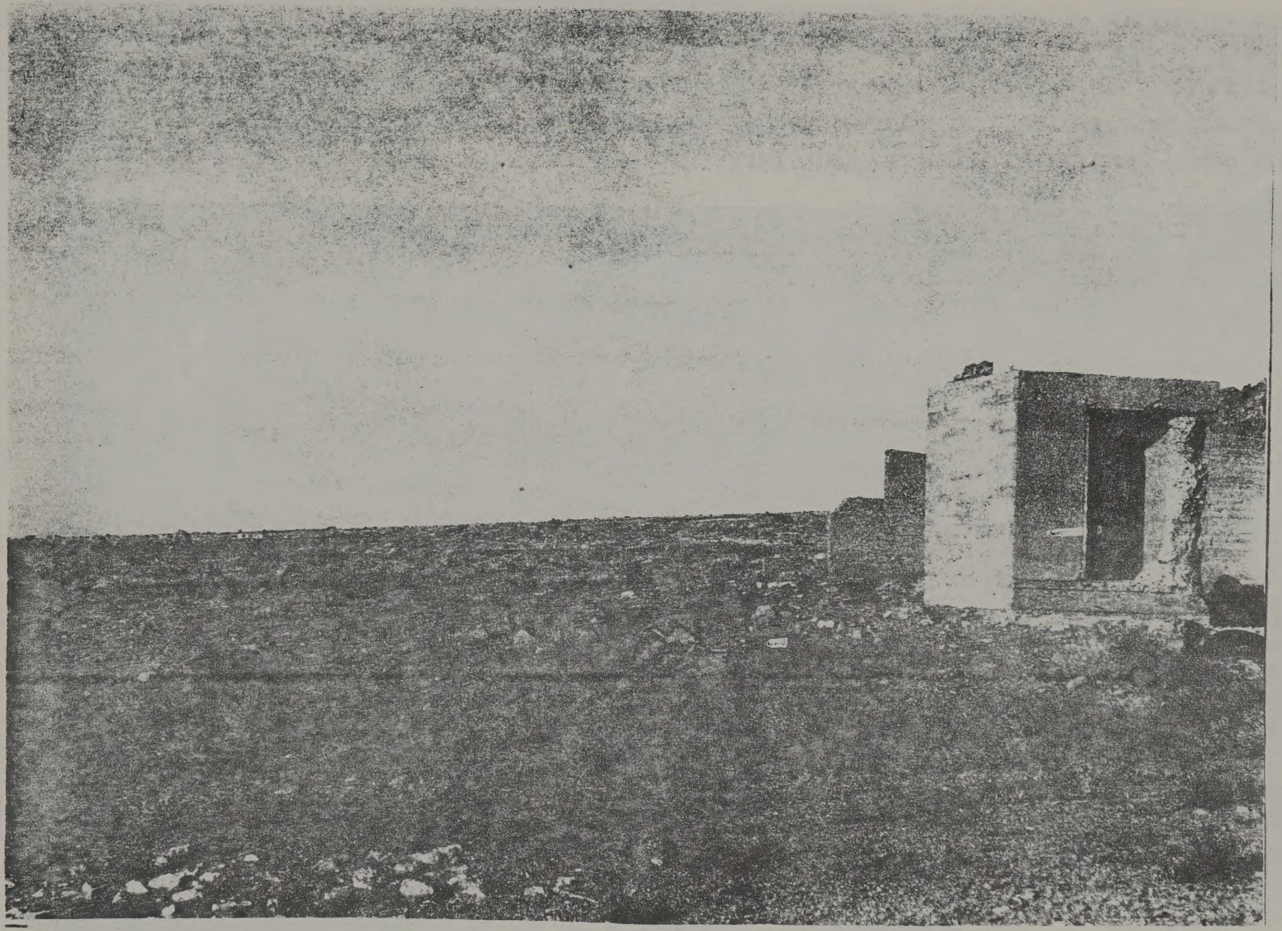


Fig. 3. Ghost town of Newhouse, with home ruins in background and smelter ruins right foreground. Wah Wah Valley, Beaver Co., Utah, December 12, 1969.

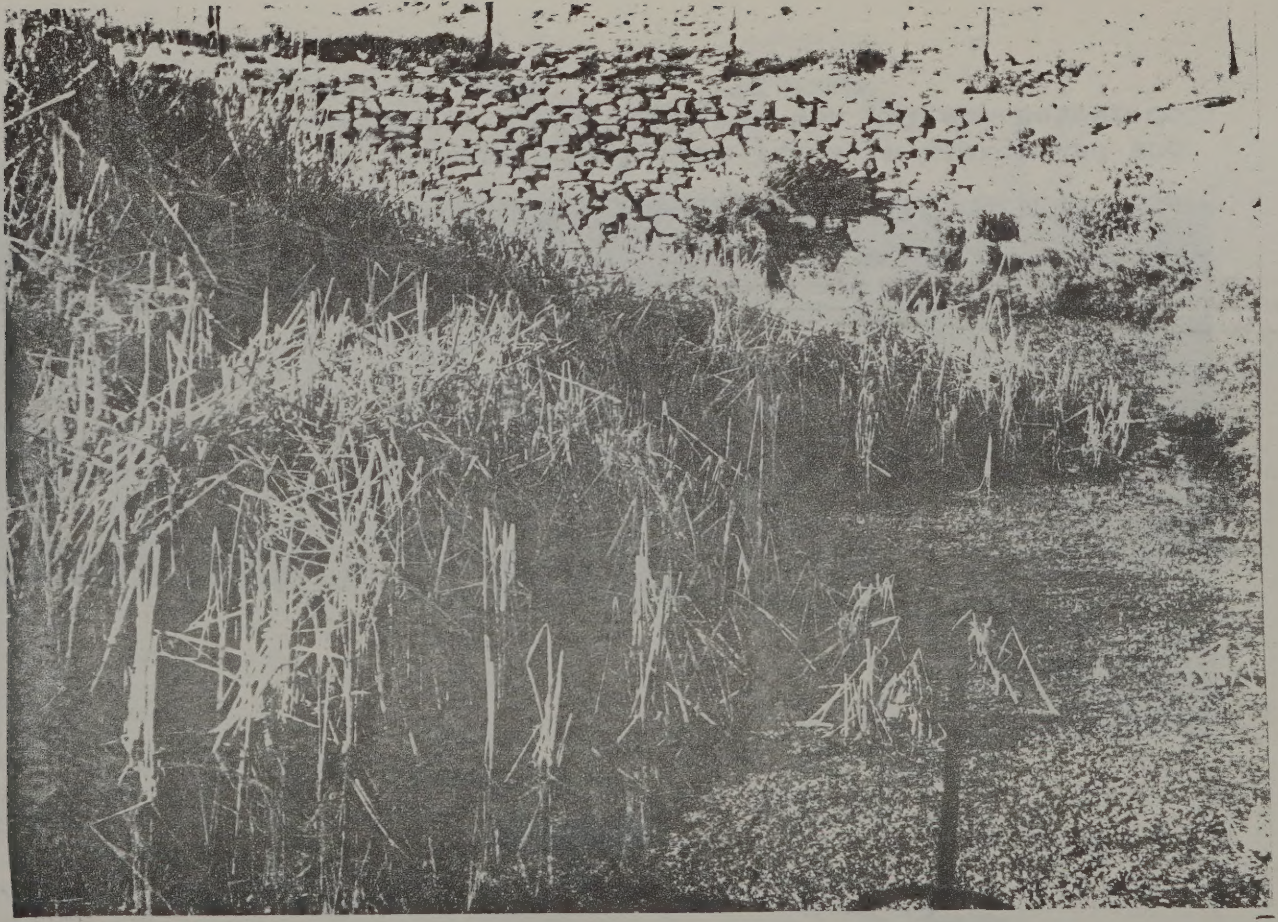


Fig. 4. Privately owned Wah Wah spring flows approximately two second feet and irrigates about 40 acres of land. The only systematically irrigated land in Pine or Wah Wah Valleys. Wah Wah Valley, Beaver County, Utah.

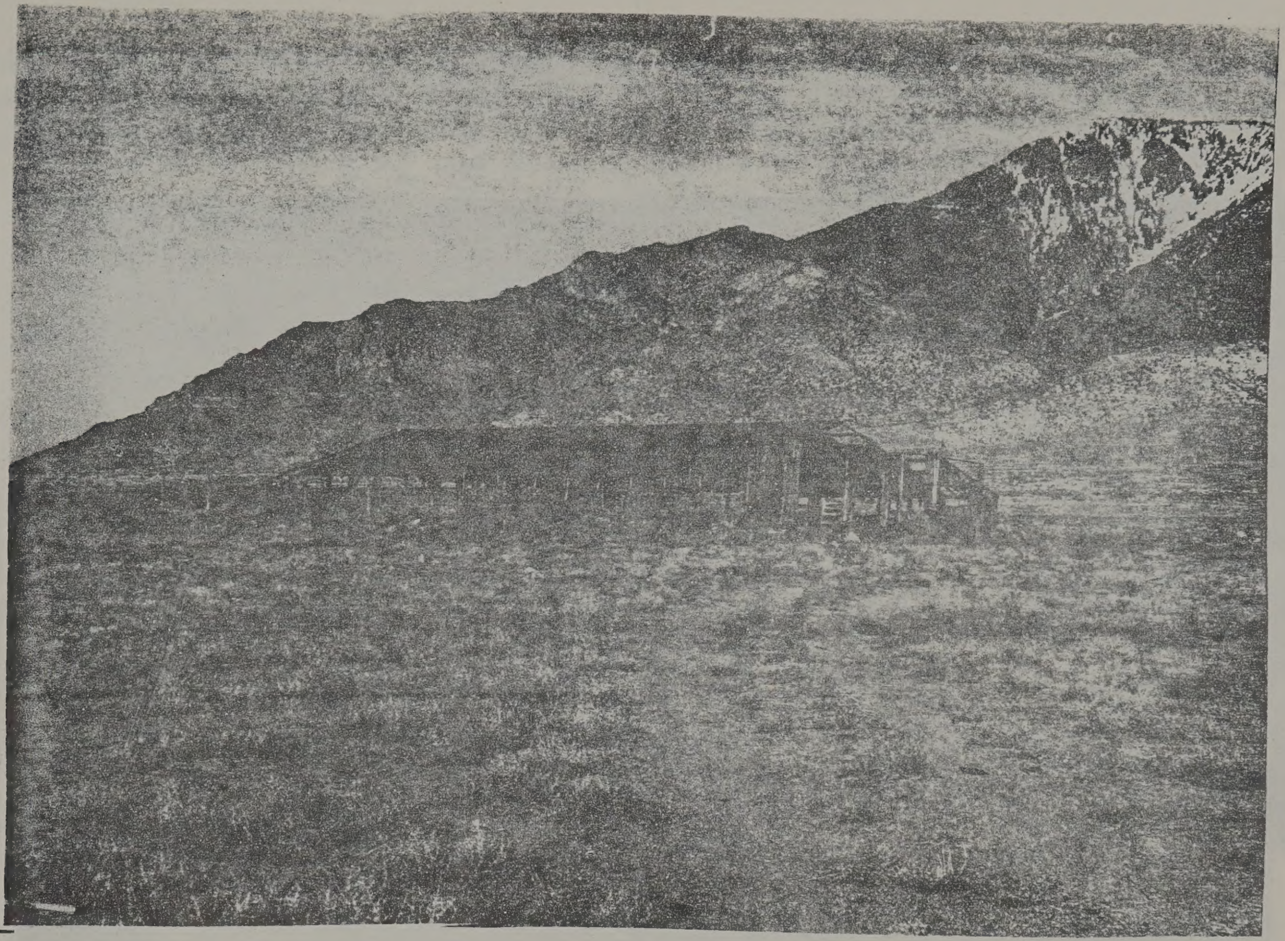


Fig. 5. Newhouse shearing sheds and corrals. As many as 200,000 head of sheep were reported to have been sheared here during a single year. Wah Wah Valley, Beaver County, Utah.

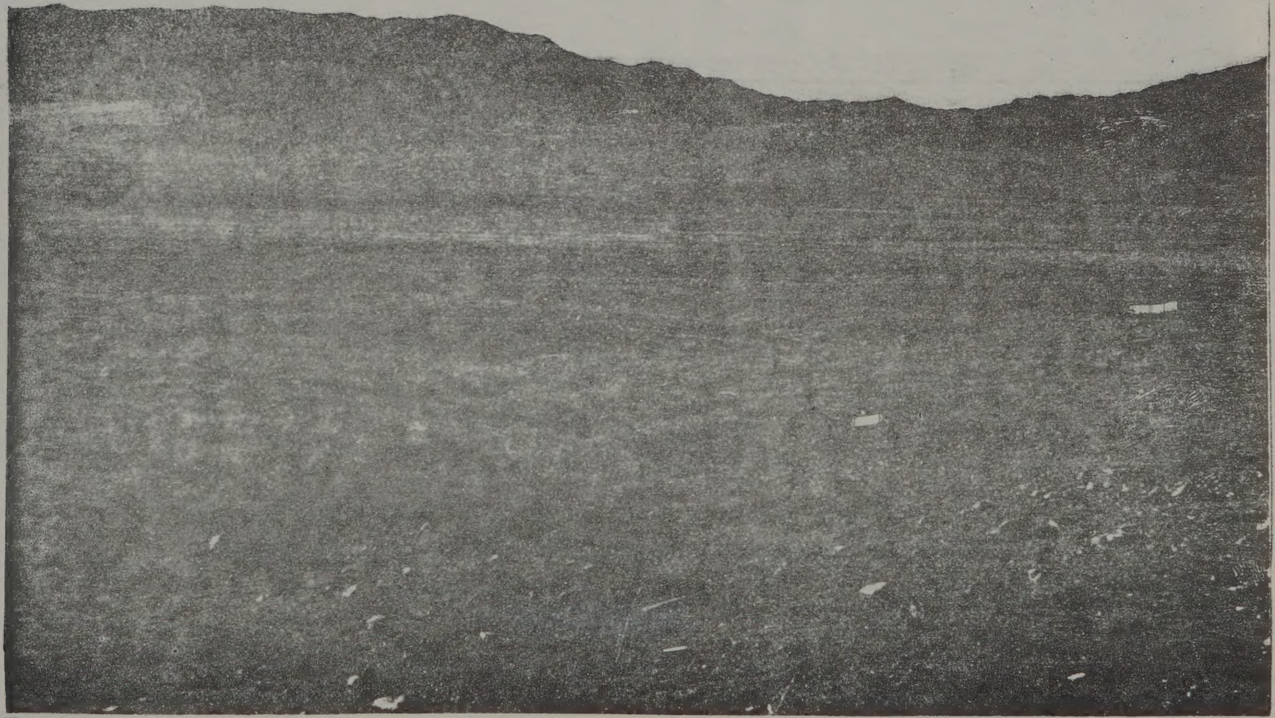


Fig. 6. Slag dump at the town of Newhouse is in the foreground. Pipeline through present day ranch continuing to the town from Wah Wah Springs is evident on valley floor. Wah Wah Valley, Beaver County, Utah.

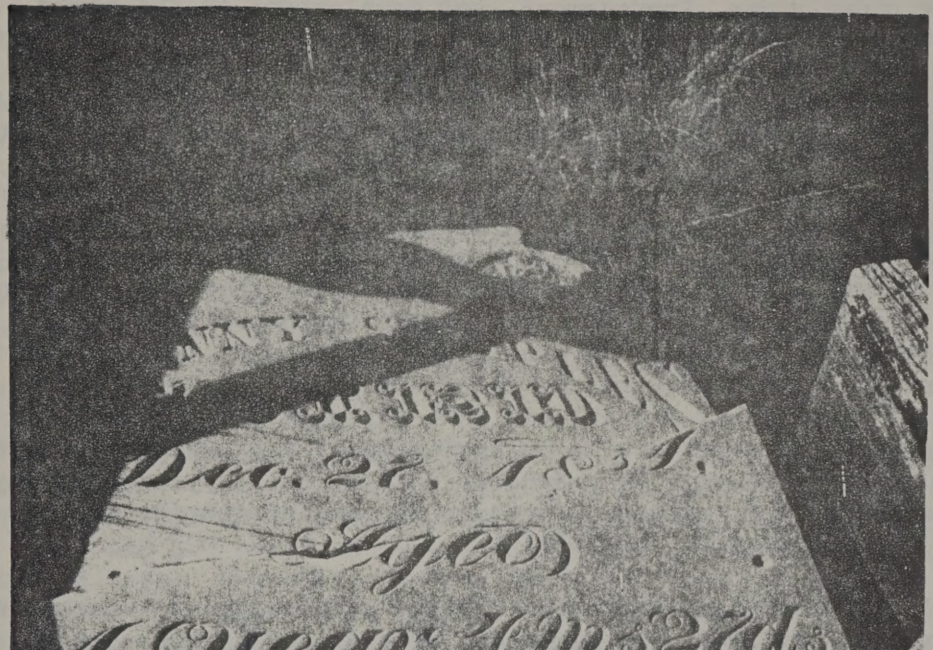

Dec. 27, 1881.
Aged
1 year 4 Ms 27ds
Tis a little grave, but Oh have care,
For world wide hopes are buried here
ns much of light how much of joy.
buried with my darling boy.

Fig. 7. Johnny Staples grave marker, December 27, 1881. This grave is typical of many in a state of decadence. Frisco cemetary, Beaver County, Utah.

preference given to landowners engaged in the livestock business. He was directed to "make provision for the protection, administration, regulation, and improvement of such grazing districts as may be created under the authority of Section 315..." and to "make such rules and regulations... and do any and all things necessary to accomplish the purposes of this chapter and to insure the objects of such grazing districts, namely, to regulate their occupancy and use, to preserve the land and its resources from destruction or unnecessary injury, to provide for the orderly use, improvement, and development of the range..." He was "authorized to continue the study of erosion and flood control and to perform such work as may be necessary subject to the provisions of this chapter, through such funds as may be made available for that purpose..." (§315a) He was further directed "to specify from time to time numbers of stock and seasons of use." (§315b)

The Act provided for cooperation with other departments of the federal government and with state agencies and local associations engaged in conservation or propagation of wildlife. Furthermore, "in order that the Secretary of the Interior may have the benefit of the fullest information and advice concerning physical, economic, and other local conditions in the several grazing districts, there shall be an advisory board of local stock men in each such district..." These boards were empowered to offer advice on applications for grazing permits, proposed rules and regulations, "the seasons of use and carrying capacity of the range, and any other matters affecting the administration of this chapter within the district." (§315o-1)

Responsibility for administration of the Act originally was vested in the Grazing Service. In 1946, the functions of this entity were transferred to the Bureau of Land Management.

The regulations implementing the Act (43 C.F.R. §§4110-15) detail how grazing privileges are to be awarded. The District Manager, after recommendation by the advisory board, establishes grazing capacities for units within the grazing district and then classifies them for the proper seasons of use and the maximum periods of time for which licensees or permitees may use them. The District Manager determines the qualifications for grazing privileges and apportions the forage production equitably among the qualified applicants. This is the procedure of "adjudication."

The Grazing Service, acting under the authority of the Taylor Grazing Act, began the task of managing what evidence indicates was a badly depleted range. The district, (Pahvant Grazing District--Utah Number 3) of which Pine and Wah Wah Valleys are a part, was established in 1935 and subdivision of the district into management units occurred in 1937 (6). By 1936, livestock operators had received licenses for specific numbers of livestock, evidently based in large part on previous practices of the operators.

Comprehensive range surveys to determine the capacity of the range to support grazing animals were not carried out on the Milford Unit, of which Wah Wah Valley is a part, prior to 1950 (6), and none is known to have been made in Pine Valley prior to that time either. However, "several estimates were made of carrying capacity by applying rule of thumb methods based on advisory board recommendations" (6, p. 29). As early as 1936, there was a tacit recognition that overstocking existed to the extent of about 30 percent, and that carrying capacity should be set at about 8.65 acres per AUM (6). (An animal-unit month, or AUM, is the amount of food necessary for the sustenance of one cow, or its equivalent - five sheep or five goats - for one month. 43 C.F.R. 84110-0-5(m)).

The Milford Unit recorded some 75,141 sheep and 952 cattle in 1936, although the number of AUM's is unknown. Between 1936 and 1950, the number of sheep declined to 58,577, but the cattle numbers increased to some 2,137. Animal-unit months are recorded for all years between 1939 and 1950. In that twelve-year period the average number of AUM's for both cattle and sheep was 87,062. However, in 1950 it was recognized that for the Milford Unit, "because of acreage differences in various tabulations, it appears that an estimated grazing capacity of approximately 70,000 AUM's has been accepted as a working basis or goal" (6, p.30). Thus, the average stocking rate in the Milford Unit from 1939 to 1950, was recognized to exceed estimated carrying capacity of the range by about 17,000 AUM's.

Pine Valley was not adjudicated until 1956, and Wah Wah Valley not until 1962. The total number of AUM's allowed following adjudication was 27,389 in Pine Valley and 29,611 in Wah Wah Valley (or about 12.9 acres per AUM based on estimated 738,000 acres of Public lands in the two valleys). These figures represent an average reduction of 32.8% for Pine and 53% for Wah Wah (1,22). Although detailed surveys of the vegetation have not been made since adjudication, there is evidence of general vegetation improvement (1, 2, 3, 4, 11) on the Federal lands.

ENVIRONMENTAL IMPACT

In the period 1910 - 1915, forage utilization by livestock was judged to have become seriously destructive to vegetation in Pine Valley (19). In the years 1915 - 1934, forage use in Pine Valley reportedly exceeded proper use in nearly, though not quite the same degree as was common in Wah Wah Valley from about 1885 - 1934 (19). Changes in vegetation during the extended period of heavy grazing by sheep and cattle resulted in death or reduction of vigor of those plants most readily eaten by livestock (e.g., budsage, black sagebrush, winterfat, and grasses) and in the increase of plants belonging to species which were avoided by livestock because of their being unpalatable (rabbitbrush), moderately palatable (shadscale) or poisonous (horsebrush) (6, 19).

Despite the increase in numbers of some species, reduction of total plant cover also resulted from the heavy grazing pressures (16, 17, 19). Because of this, erosion proceeded at an accelerated rate, and the Pine-Wah Wah Valley region was designated as being "moderately" to "severely" eroded (6). As early as 1936, it was noted that the pedestaled nature of many desert plants, especially winterfat, showed that from one to six inches of soil had been removed from below the crowns since their establishment. This was true regardless of age of plants. Some were only a few years old and were pedestaled as much as the old plants, indicating recent erosion (19). Embryonic sand dunes were also noted (6, 19).

That the drought of 1934 was a major factor in decline of vegetation and in soil erosion has been discounted by various writers (19, p. 290-291; 6). It has been noted that there was a drought from 1897-1904 which was of equal or greater severity than that of the early 1930's. Yet, "fat sheep were marketed on the desert range in mid-winter during the decade 1895-1904, according to the testimony of resident stockmen" (19, p. 291). And indeed, as early as the year 1928, more than 4,200 head of sheep out of a band of 5,000 starved to death in Pine Valley (22), well before the drought of the 1930's became severe. "The evidence is that in the early days, the damaging effect of acute shortage of moisture in drought years was offset by moderate utilization, which permitted restoration of the normal growth and nutritional function of the range plant" (19).

Another change in plant cover demonstrated in many parts of Utah was the invasion of juniper and pinon from the mountain slopes downward onto the deep alluvial soils of the valleys. Neither pinon nor juniper are eaten preferentially by grazing animals and both increase and spread when plants more readily eaten are destroyed by grazing. Photographs taken at the townsite of State Line (Figs. 8 & 9), a mining camp in the White Rocks Range at the south end of Hamblin Valley, Iron County, Utah, in 1909 and 1959 show a striking change in the juniper-pinon woodland. The trees have increased in number on the hillsides and have extended their range into the low-lands. Even the 1909 photograph demonstrates that the migration was already well advanced, adding support to the idea that native vegetation is rather quickly transformed under heavy grazing pressures. Hamblin Valley is the next valley west of Pine Valley and the State Line site is comparable to portions of the south end of Pine Valley now occupied by juniper and pinon also. In the late 1950's and early 1960's, a program was initiated by the Bureau of Land Management in cooperation with the Soil Conservation Service and certain of the private livestock operators to improve suitable lands covered with juniper and pinon. Expansion of the juniper-pinon woodland over the years had reduced usable forage production in many places to an amount estimated at less than fifty pounds per acre. The trees were removed and the lands were planted to grass. The resulting forage production represented a 10 to 100-fold increase in usable forage (2, 3). This increase in forage production has made it possible to initiate changes in the season of use for some of the livestock operators. Now there is available high quality forage at higher elevations which allows relief for the vegetation in valley bottoms during the summer season. The Bureau has reseeded some 14,500 acres of juniper-pinon woodland.

It is interesting that following the reseeding of the woodland type there was an increase in water yield from those lands. Streamflow in adjacent tributaries increased and the season of flow lengthened. This is true not only on the Federal lands, but also of Utah State lands where 5,500 acres of juniper-pinon woodland have been cleared and planted to browse plants for wildlife. The improved water regimen has made it possible to construct recreation pools (Fig. 10) for fishing purposes, and has increased the amount of water available for livestock and for wildlife.

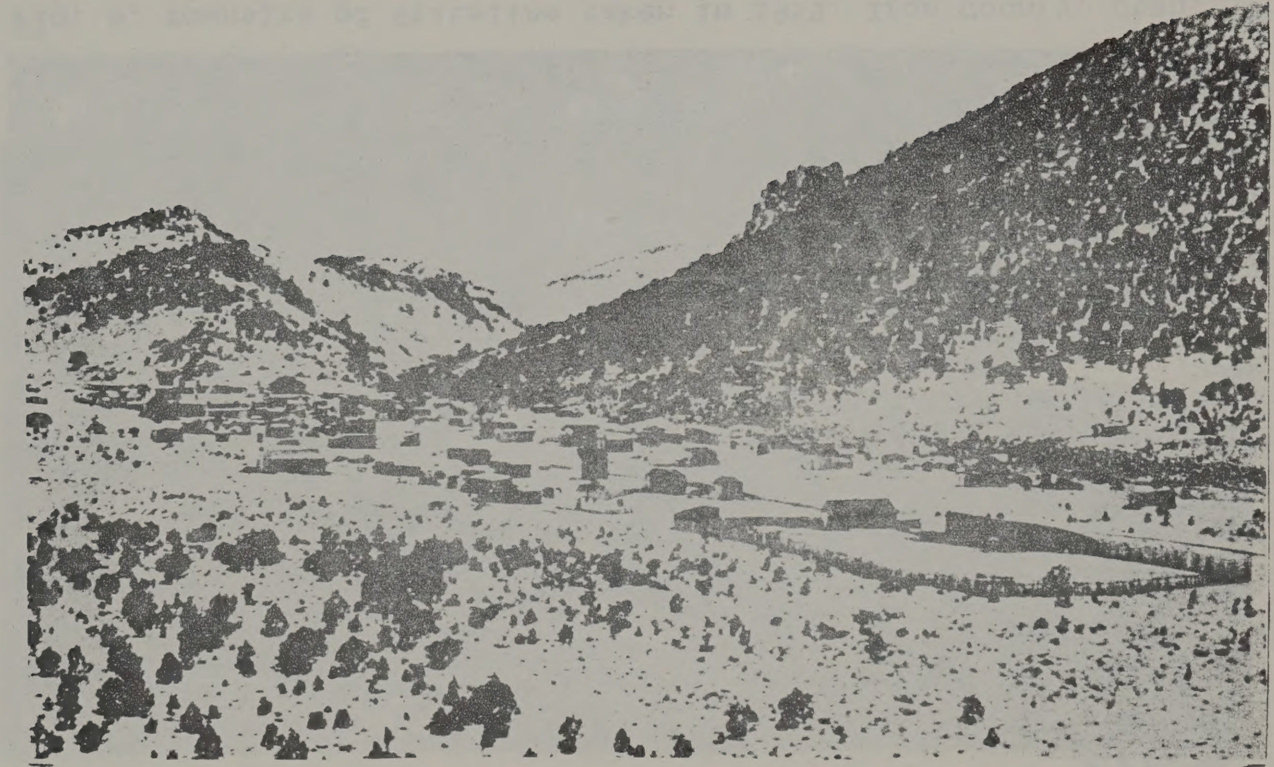


Fig. 8. Townsite of Stateline taken in 1909, Iron County, Utah. Note sparsely scattered, small trees near town and on slopes in background. Photo courtesy BLM.

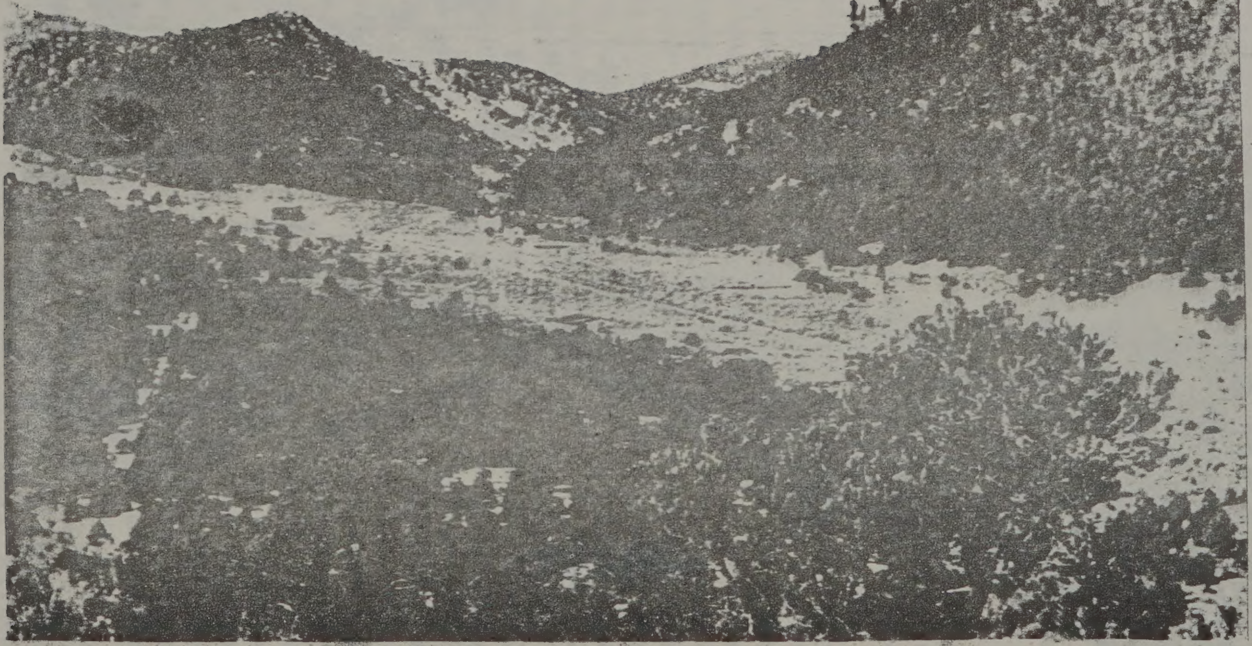


Fig. 9. Townsite of Stateline taken in 1959. Iron County, Utah. Much less bare area is evident between trees in just 50 years of reduced competition with forage species due to grazing. Photo courtesy BLM.

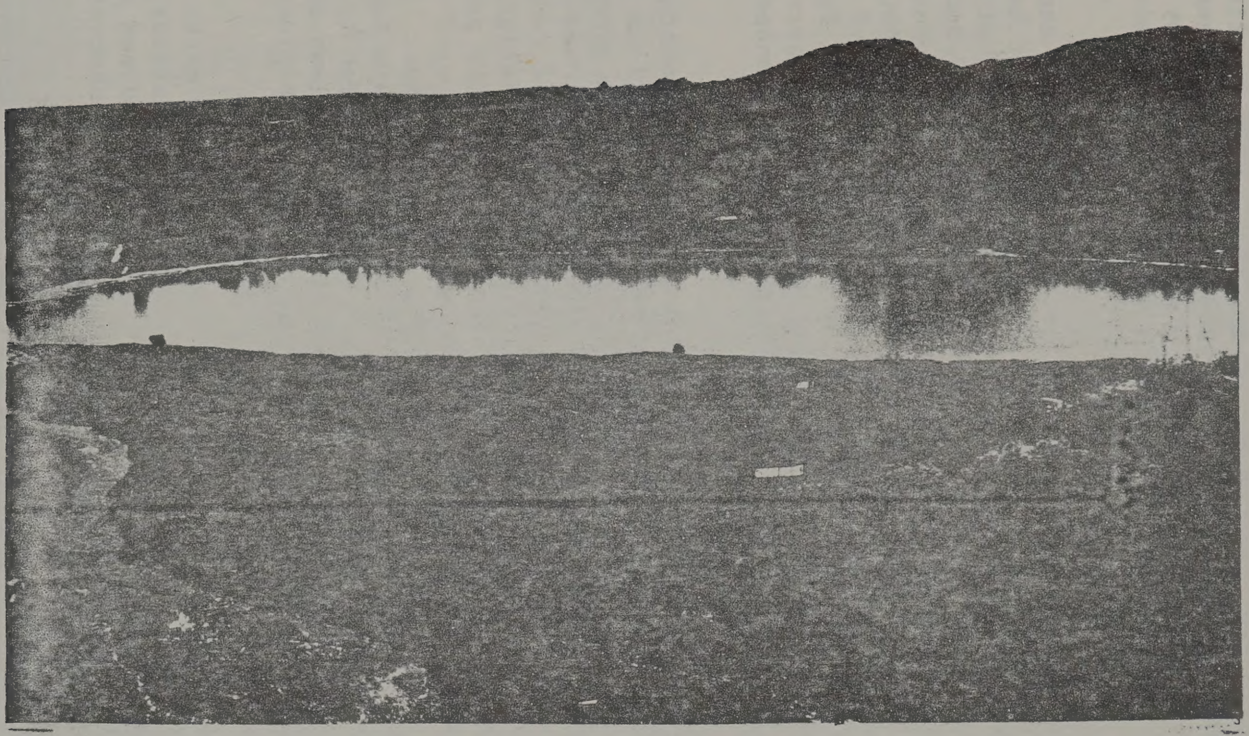


Fig. 10. Utah State Department of Fish and Game pond partially silted in by flood. Increased water supplies are the result of cleared lands above. Pond has provided fish up to 18" long. Indian Creek, Indian Peak, Pine Valley, Beaver County, Utah.

Continuous, poor road grading practices have resulted in the year after year lowering of the roadbed below the level of the adjacent terrain. A windrow is often produced on the down-slope side of the road (or on both sides) and has changed the roads into "canals" (Figs. 11 running along and often downhill for long distances. Runoff from excessive rainstorms collects and contributes to erosion of great magnitude. During winter storms, the roads become drifted in and unpassable whereas the surrounding areas are free from snow. With unnatural water diversion the vegetation has been altered, often with a complete change of dominant species in many areas in Pine and Wah Wah Valleys. The maintenance of roads on Federal lands is done by the counties which are subsidized by the state which in turn receives Federal funds for this purpose (15).

Proper grazing practices may make it necessary to build access roads, fences, corrals, and certain ranch buildings. The Bureau of Land Management has policies regulating the location and construction but some facilities leave much to be desired (Fig. 13). State and Federal policies often lack consistency. State land policy allows for the construction of lambing sheds on land contiguous to Federal lands, even though they are not allowed on the Federal lands (Fig. 14). The effect of such a structure (even though built on State lands), on vegeta of adjacent Federal lands is the same. Animals are concentrated, and vegetation is destroyed. The same is true for such structures on private property surrounded by Federal lands.

Non-grazing practices that have contributed to environmental changes are those resulting from mining and mining-related enterprises (Fig. 6). Abandoned mine buildings and machinery (Fig. 15), old coke ovens, (Figs. 16 & 17), smelter (Fig. 6), foundary (Fig. 18), railway, townsite, homesite, Fig. 19) and graveyard (Fig. 7) are all evident in the area considered in this study. Modern mining exploration is evident also. Enlightened range management practices do little good if mining exploration is permitted that does not respect the Bureau of Land Management's supposed regulation of Federal lands. Here State and Federal regulations differ. To explore for minerals on State lands requires a permit from the State Land Board (5). However, any part of the Federal lands can be explored by bulldozer, plow, shovel, or any other means as long as State filing laws are followed (21). The Bureau of Land Management finds out about the exploration only after the fact.

Attempts at ranching and farming have also left their marks on the landscape in the form of fields (Fig. 20), abandoned farmsteads, (Fig. 21), springs (Fig. 4) and cemetery (Fig. 1). Many of the abandoned structures are of significant historical value and are in need of preservation. Others are eyesores and should be obliterated.

Although there is a stated policy by the Bureau of Sport Fisheries and Wildlife concerning the animal damage control programs, it appears that certain indiscriminate killing occurs of animals that are considered by some individuals to be "problem animals," (7, p. 449). This problem is compounded by both private and government trappers working a region without correlation of results. A total list of animals killed and dumped

Fig. 11. Road way diversion of natural drainage causing change in vegetation type. Four-wing saltbush on left and scattered shadscale on the right. South central Pine Valley, BLM Lands, Beaver County, Utah.

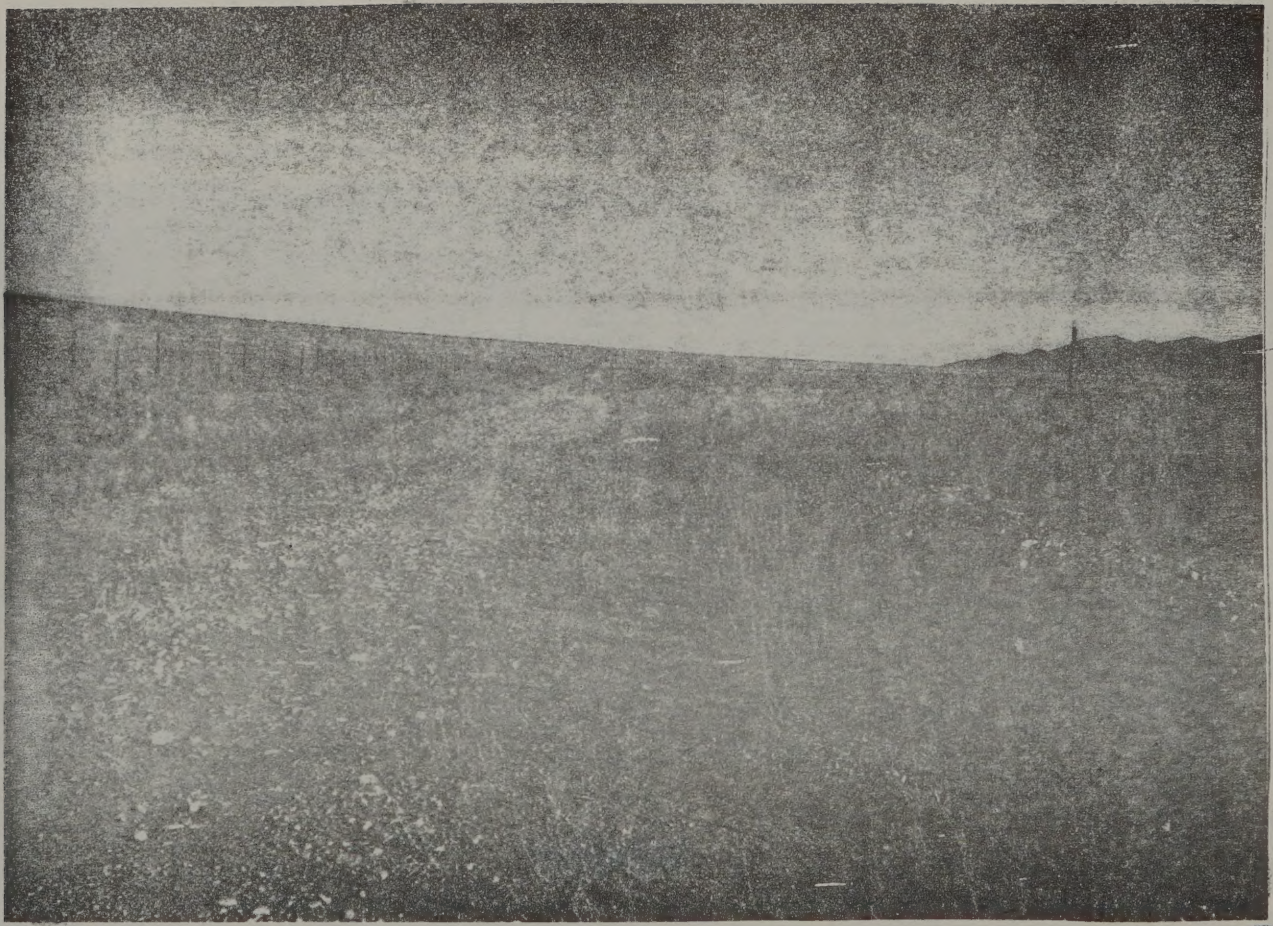


Fig. 12. Halageton and windrow lined roadway. The road now acts as a canal during periods of heavy rain. BLM lands, north end of Wah Wah Valley, Millard County, Utah.

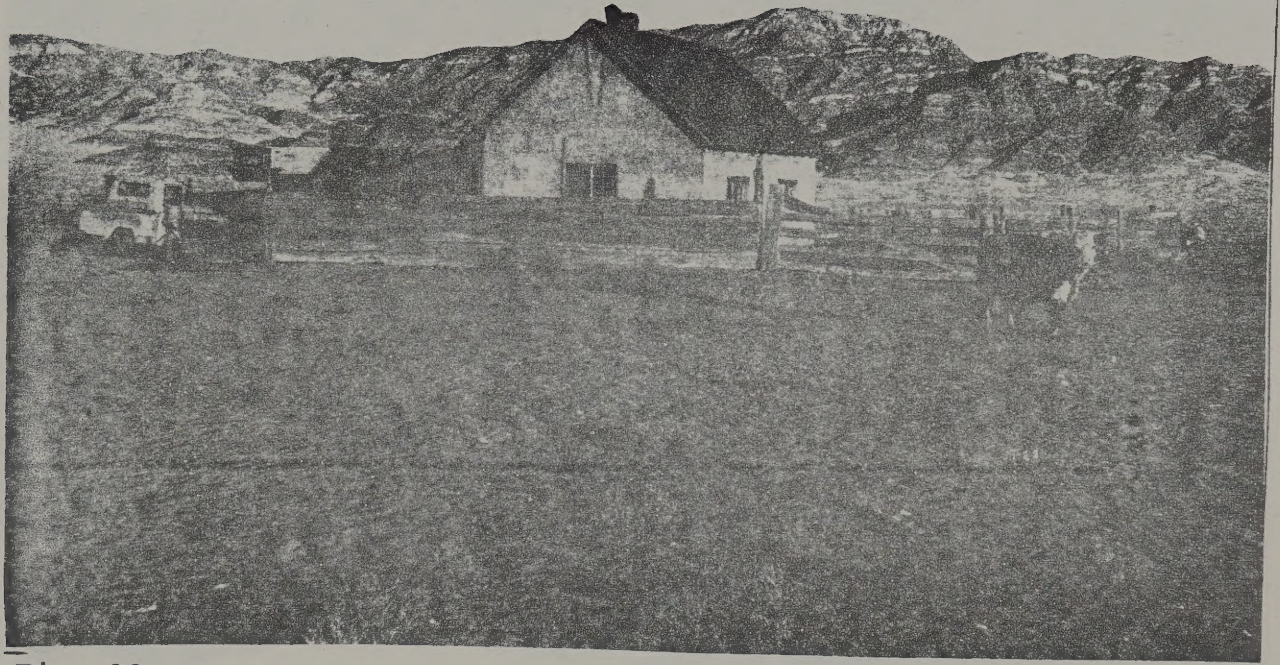


Fig. 13. Woods' cabin and well. The effect of high concentrations of livestock is evident for several hundred yards in the immediate vicinity. Pine Valley, Beaver County, Utah.

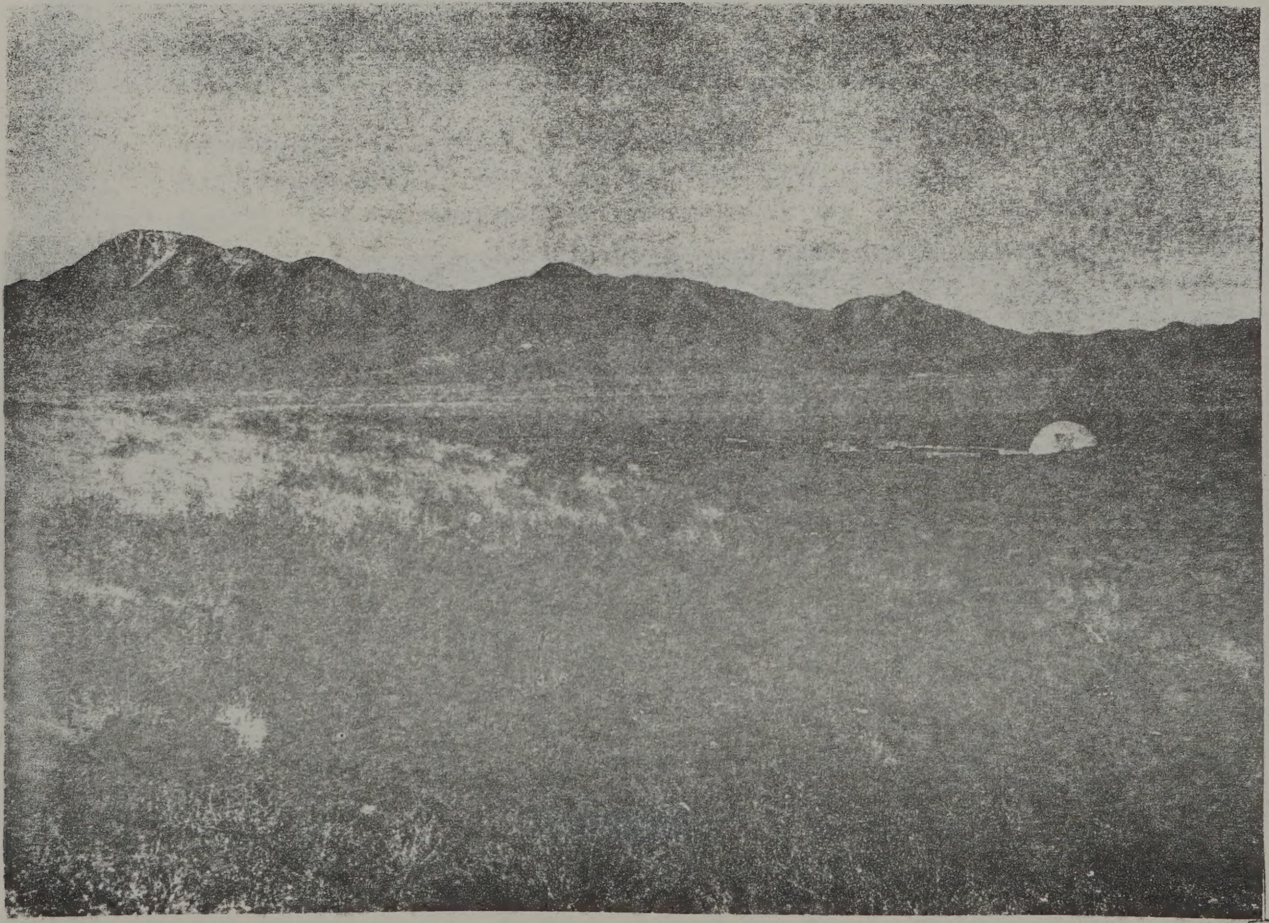


Fig. 14. Lambing shed and corrals on State lands in south end of Wah Wah Valley, Beaver County, Utah.

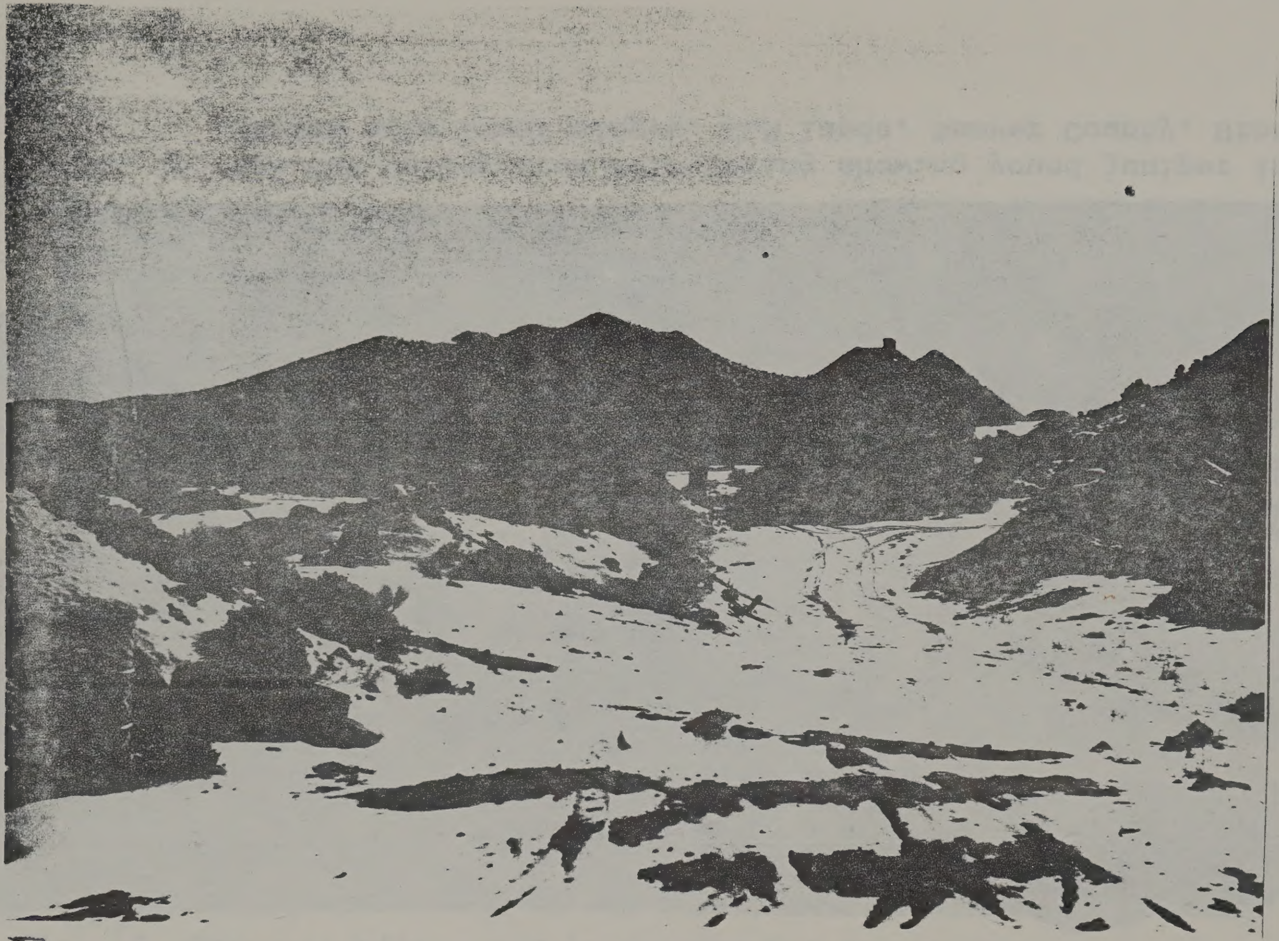


Fig. 15. Abandoned mine buildings and mine dump, Frisco, Beaver County, Utah.

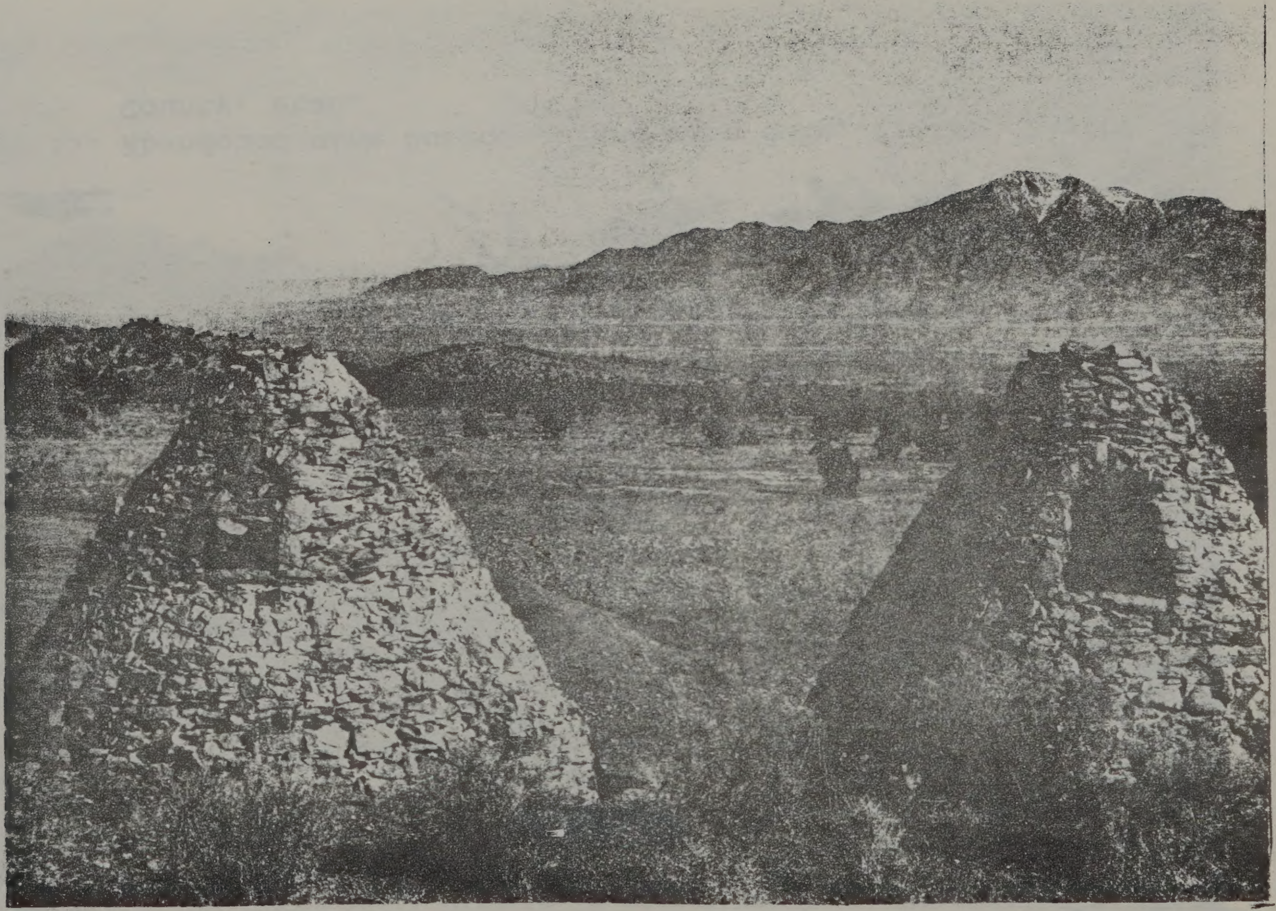


Fig. 16. Wah Wah Valley from Kiln Spring showing yound juniper invasion onto lower slopes. BLM lands, Beaver County, Utah.

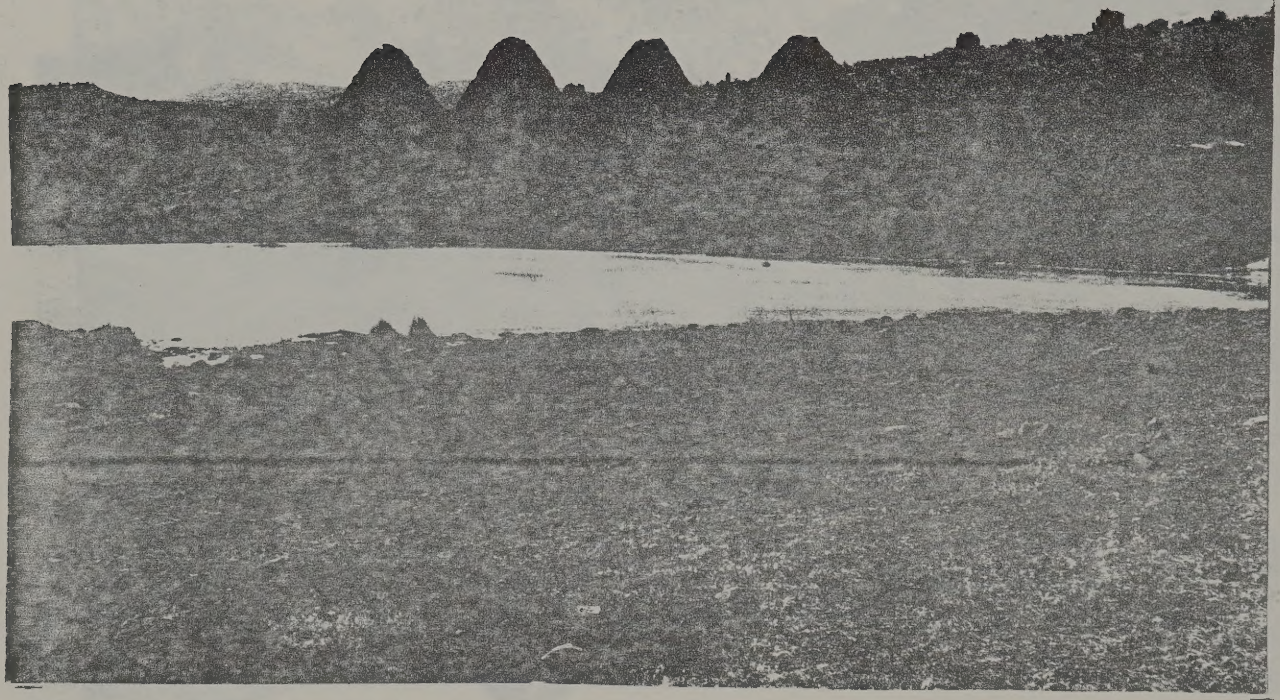


Fig. 17. Charcoal kilns at Kiln Spring, Wah Wah Valley, Beaver County, Utah.

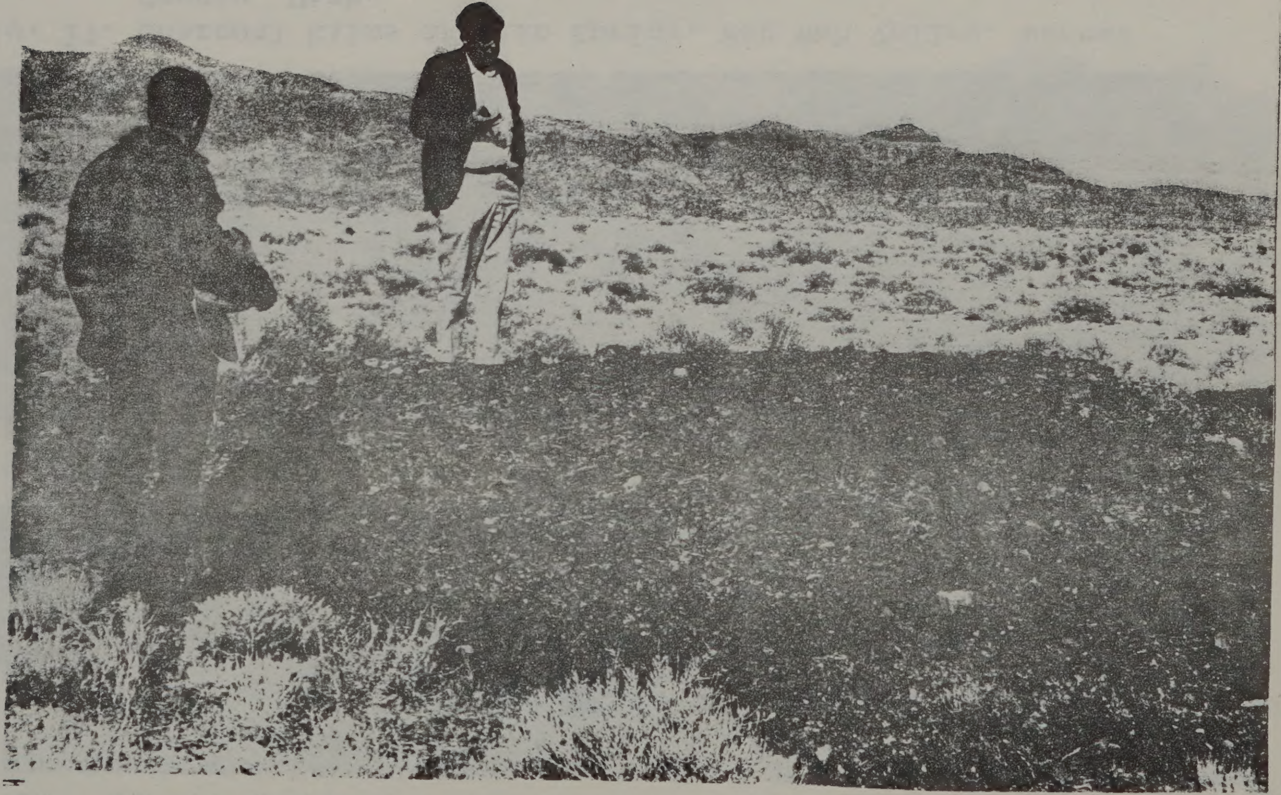


Fig. 18. Slag pile from old iron works. West side of Wah Wah Valley, Beaver County, Utah.

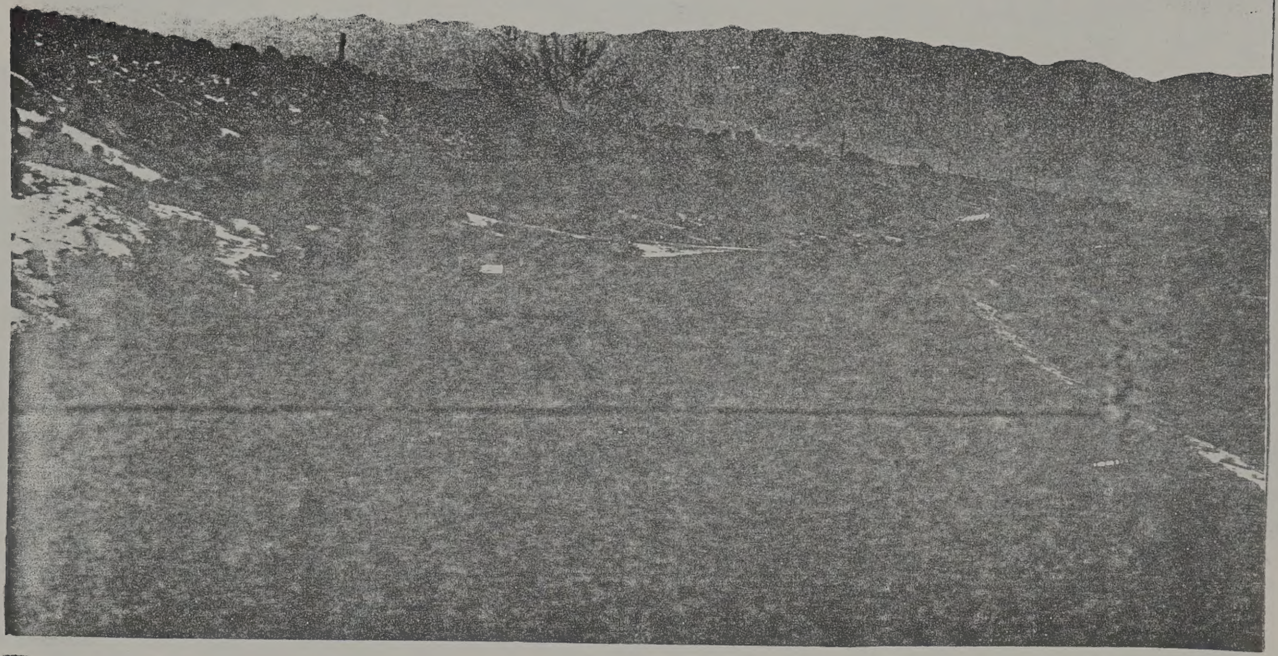


Fig. 19. Abandoned buildings, Squaw Spring, Wah Wah Valley, Beaver County, Utah.

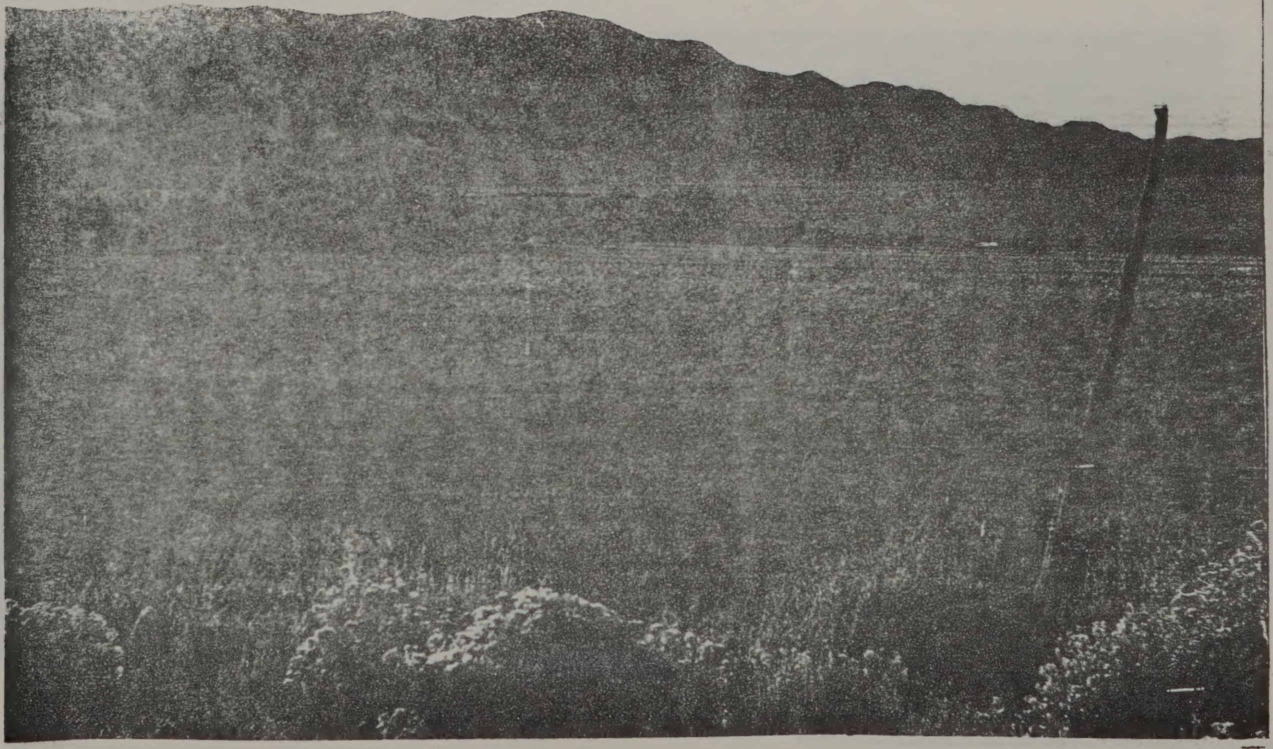


Fig. 20. Wintch Ranch alfalfa field approximately 40 acres irrigated from Wah Wah Spring. Wah Wah Valley, Beaver County, Utah.

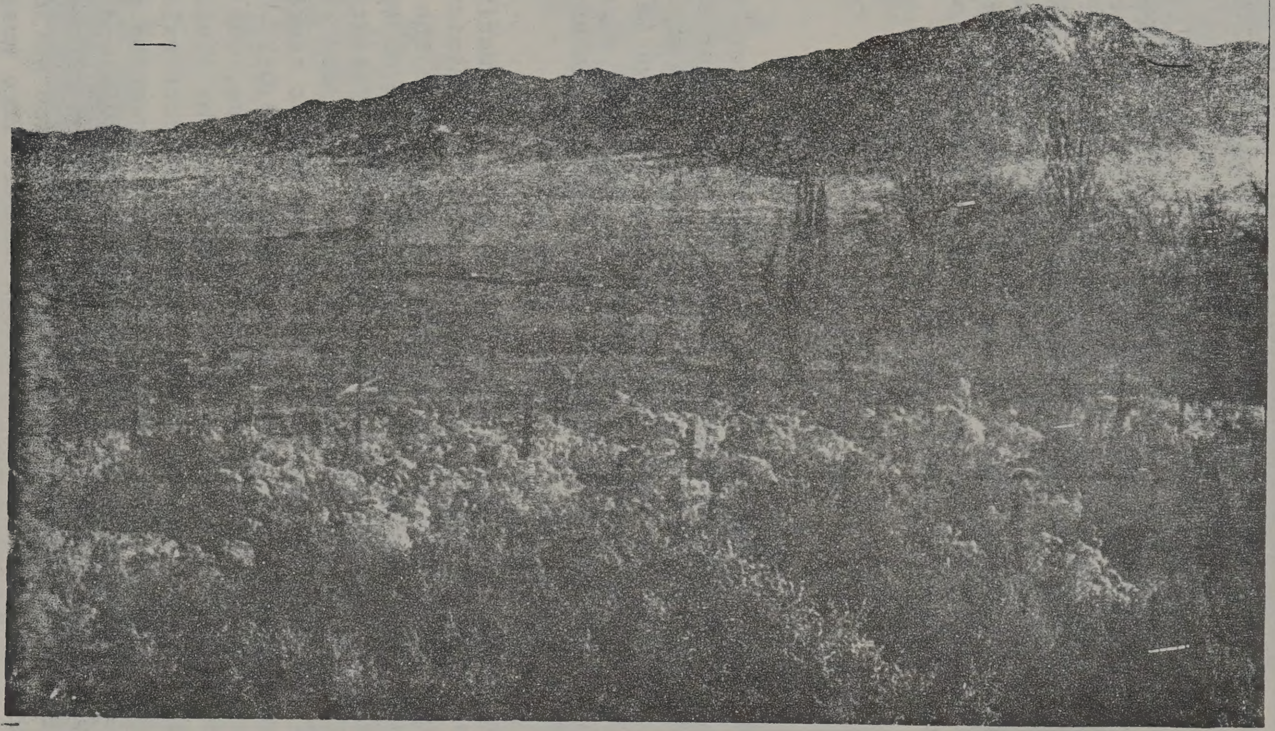


Fig. 21. Abandoned farmstead in foreground with modern corral in background. Wah Wah Valley, from Wah Wah Spring, Beaver County, Utah. December 13, 1969.

along a crossroads junction for all to see on December 13, 1969, included two badgers, two bobcats, five gray fox, one kit fox and one long-eared owl (Fig. 22). These were apparently taken by a private individual but the region is also marked as containing cyanide devices and the poison "1080" (18).

If "it is the objective of the Bureau to reduce animal depredations as selectively as possible" (23, p. 5), then a lack of proper execution of the policy occurs at the local level. Federal, State, and County programs need further enlightenment through research and coordination before the objective is achieved.

An illustration of problems arising from high rabbit populations (possibly as a result of low predator numbers) is attempts at reseeding a cleared, juniper-pinon area by the Utah State Department of Fish and Game. In 1963, they were forced to re-restore some five hundred acres of land initially reseeded in 1958, in the Indian Peaks region of Pine Valley. Small acreage reseeding projects in the south end of Wah Wah Valley may be doomed to failure because of the high numbers of rabbits feeding on the newly-planted vegetation (2).

PROBLEM ORIGINS

Prior to 1934 and the Taylor Grazing Act, the lands were grazed at excessive rates, and no Federal agency exercised management authority. It was not until after the passage of the Act that a land management agency began to exercise the authority to control the ways in which the land was used. Of course, the type of land use, grazing, already was firmly established, but Interior did have the authority to begin regulating that land use, although it did not move quickly.

Interior's management role was complicated by its objectives. The regulations provide that: "Grazing districts will be administered to conserve and regulate the public grazing lands, to stabilize the livestock industry dependent upon them... In furtherance of these objectives, grazing privileges will be granted with a view to the protection of those livestock operations that are recognized as established and continuing, and which normally involve substantial use of the public range in a regular, continuing manner each year." 43 C.F.R. §4110.0-2. In 1934, the lands were already over-grazed. Interior, therefore, was faced with a dilemma: it could conserve the range and undercut the livelihood of livestock operators of long-standing, or it could protect existing livestock operations at the cost of continuing poor conservation practices. Interior apparently tried to do both. Through the 1930's and 1940's, the Depression and World War II dictated the protection of the existing livestock operations. It was not until after the Second World War that any real steps toward reduction of livestock numbers were possible. Steps then were taken which resulted in the adjudication actions of 1956 for Pine Valley and 1962 for Wah Wah Valley.

Prior to 1934, there was no coordination among interested agencies. Since that time, there has been coordination in varying degrees among all

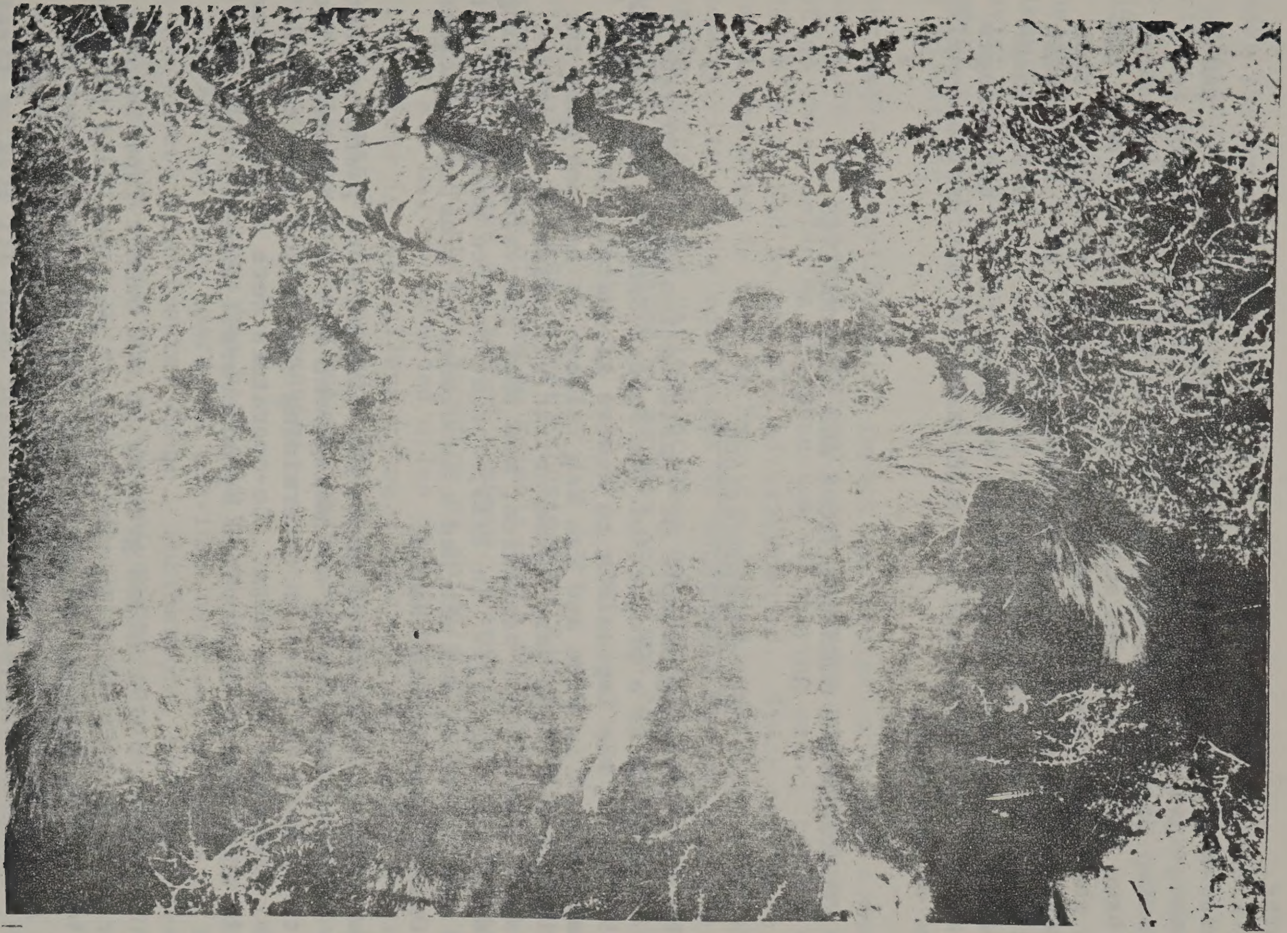


Fig. 22. Cadavers of two gray fox and a bobcat abandoned after most valuable pelts had been removed. South end of Pine Valley, Beaver County, Utah. December 13, 1969.

Federal, State and local agencies, but the coordination has not always been timely or completely effective. The policies of the various agencies are still sometimes at cross purposes. For example, lambing sheds are allowed on state lands but not on federal lands. However, there are good examples of coordination, notably the reseeding projects undertaken in the two valleys. For these projects the BLM, Soil Conservation Service, and private individuals coordinated their activities and produced excellent results.

Interior has been perennially understaffed and, consequently, unable to study and manage grazing lands. This problem is aggravated by including the Grazing Service with the General Land Office. Furthermore, BLM personnel have not always been scientifically qualified to make the best judgments about environmental impacts. It must be remembered that even today we are only beginning to understand the complex forces which allow the development and maintenance of an eco-system. Finally, lack of funds has plagued the BLM. The Fillmore District of the BLM manages some five and a half million acres, yet there are only six professionally trained persons on the staff.

ENVIRONMENTAL CONSIDERATIONS AND ALTERNATIVES

a. Considerations

Probably the most striking example of consideration of the environmental impacts of grazing is a project of the Forest Service, not the BLM. In the early 1930's, it was impossible to assess adequately the total number of animals grazed in Pine and Wah Wah Valleys or to know what the carrying capacity of the range was. However, it was possible to detect that the vegetation was in poor condition, and that its value for grazing was greatly reduced (16, 17, 19). In 1933, Forest Service people who were concerned with the situation and who had a knowledge of grazing practices initiated the Desert Experimental Range.

The range was given a peripheral fence and divided into pastures where experiments in differential grazing and management were established. The most modern methods were utilized in determining vegetation quality and quantity, animal usage and other data. Co-operators were allowed to graze sheep and cattle in pastures as provided by an overall experimental design (14).

A study of 23 years of controlled grazing at the Desert Experimental Range was undertaken in 1958 (9). In that study it was concluded that the palatable species (i.e., budsage and winterfat) have increased, and the less palatable shadscale has decreased in relative importance during the 23 year period. These conclusions are consistant under all grazing treatments, except on those heavily grazed in springtime. The same type of improvement was noted for black sagebrush in 1964 (20), and for budsage in 1966 (25). Galleta grass increased in relative importance in all plots which supported that grass in 1935 (9).

It should be noted, however, that the heaviest grazing at the Desert Experimental Range (9 acres per AUM) was thought to be less than that of livestock operations in the remainder of Pine and Wah Wah Valleys (roughly 6 acres per AUM, as extrapolated from adjudication figures). Moderate grazing pressures at the Range were stocked at the rate of 13 acres per AUM; and light grazing at 18 acres per AUM.

Under the experimental treatments at the Desert Experimental Range, the vegetation has been improved and maintained at a high level. At the same time, livestock grazed there have provided greater economic return in the form of increased yield of wool, lambs, and healthy breeding stock (12, 14).

The Bureau of Land Management was aware of the studies at the Desert Experimental Range. In 1952 (6, p. 31), it noted that "similarity of vegetation and environment makes the results of experimental studies of management of winter sheep ranges applicable in the Milford unit with little adjustment."

There were no environmental impact studies prior to the commencement of grazing in the valleys. However, studies were made prior to the adjudication thus replacing the practice of relying upon "rule of thumb" procedures developed by the BLM advisory board. Since that time, the management agencies do seem to have considered stability, diversity and productivity of the eco-system in management decisions. The reseeding projects in the valleys provide one example. The eco-system was modified from one dominated by juniper and pinon to one with high quality forage grasses.

Both the BLM and the Desert Experimental Range have attempted to determine the number of grazing animals which will bring about a balance between usable forage and animal numbers. Water distribution and development is critical to prevent crowding of animals around troughs, springs and wells. The BLM has constructed miles of pipeline from springs to distribution points in the valleys below. Some allotments are fenced to allow for greater control of grazing. The destructive grazing practices to which these measures are directed are the environmental impacts considered to be most important by both agencies.

Public participation has been and is an integral part of agency planning. The BLM advisory board has provided numerous services to the BLM and to the Desert Experimental Range. Furthermore, both agencies have benefitted from the expertise of the university people in Utah and in other states.

b. Alternatives

Several alternatives for improving the management of grazing lands already have been suggested: improved coordination, the addition of ecologically trained personnel and an increase in funding. Furthermore, with many thousands of acres of juniper-pinon woodland available for management, it would seem that further emphasis should be placed on evaluation of their highest potential use. Pinon is valuable as firewood, for Christmas trees and as a producer of edible seeds. Juniper is cut for fence posts. The harvest is regulated by the Bureau of Land Management. However, information on highest potential use and sustained yield production is unknown. It would seem that formulation of management policies is appropriate and necessary.

Evidently, further destruction of the grazing resource base can be avoided by following regulations and policies now in effect. However, there are long-standing problems which cannot be solved entirely by changes in AUM's nor by reseeding operations. Some of the problems are illustrated by observing the permanent influence of sheep bedgrounds (Fig. 23) where Russian thistle, a weedy, Old World introduction, now occupies these bedgrounds even after 30 years of not being used for this purpose. Where watering troughs (Fig. 24), shearing sheds (Fig. 5), or dwellings and corrals for base operation of ranches (Fig.13) have been located, there is evidence of low quality (Figs. 25, 26), or even poisonous plant (Fig. 27) introductions into the area. These sites are not only detrimental to good grazing practices, but are unsightly blights on the landscape (Figs. 28, 29). These evidences of vegetation response to man's activities further emphasize that the plant community or ecosystem achieves a complicated balance only after many years of change. The balance is so delicate that whenever a deteriorating influence such as overgrazing or trampling is introduced, the effect is immediate and of long duration. The incidence of high animal concentrations centrally located as a result of the practice of trailing sheep to a water trough or shearing shed are practices that can be or have been changed. Certain practices and structures are necessary if grazing is to continue, but some detrimental practices should be altered or abandoned altogether. Even though the general quality of forage plants is improving, there are still differences between vegetation under controlled grazing within the Desert Experimental Range and the Public lands outside where grazing pressure has been much heavier (Figs. 30 & 31). Vegetation changes resulting from poor grazing practices certainly emphasize the need for sound management toward improving the quality of the land.

Less desirable, low quality or poisonous forage plants can be replaced by species that will improve habitat for livestock as well as wildlife. Enlightened management practices, such as the adjudications of 1956 and 1962, can result in rehabilitated rangelands (Fig.32) through removal of undesirable species. Reseeding (Figs. 33 & 34) can also result in better forage production.

By maintaining good management practices, the inroads of undesirable or poisonous, Old World plants can be kept at a minimum. Prior to 1934, cheat grass, Russian thistle and horehound were introduced in Utah and found adequate habitat in our grazing lands. Between 1934 and the present, the poisonous plant Halogeton spread throughout winter sheep ranges; another poisonous plant, henbane, was noted in Pine Valley in 1962 (11) and is spreading along sheep bedgrounds and trails.

The practice of water development projects for wildlife as well as livestock have been largely neglected. Many water development programs

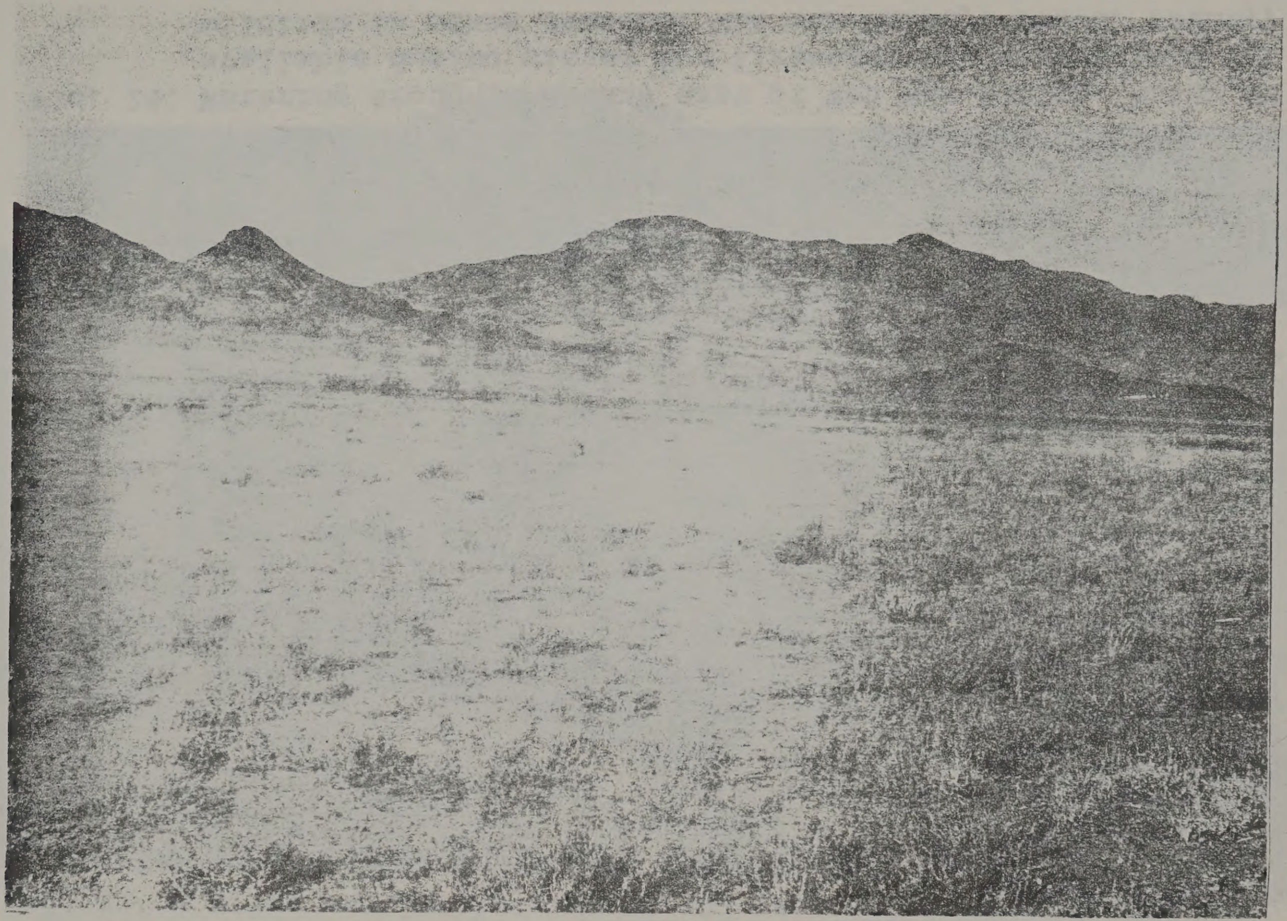


Fig. 23. Sheep bedground is dark area on knoll in the center background and is dominated by Russian thistle. Antelope Valley, Desert Experimental Range, Millard County, Utah.

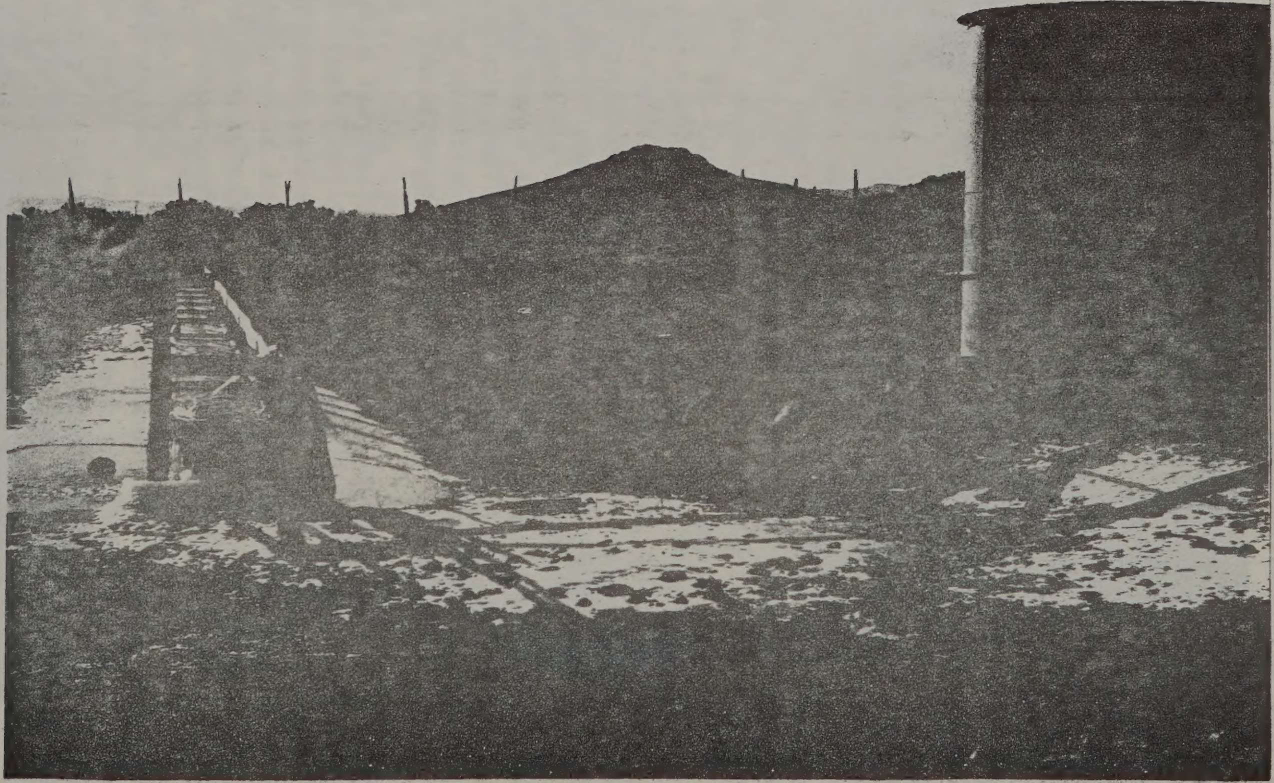


Fig. 24. Watering trough and tank east of Wah Wah Spring. Water is available during winter for livestock but unavailable for wildlife in other seasons. Wah Wah Valley, Beaver County, Utah.

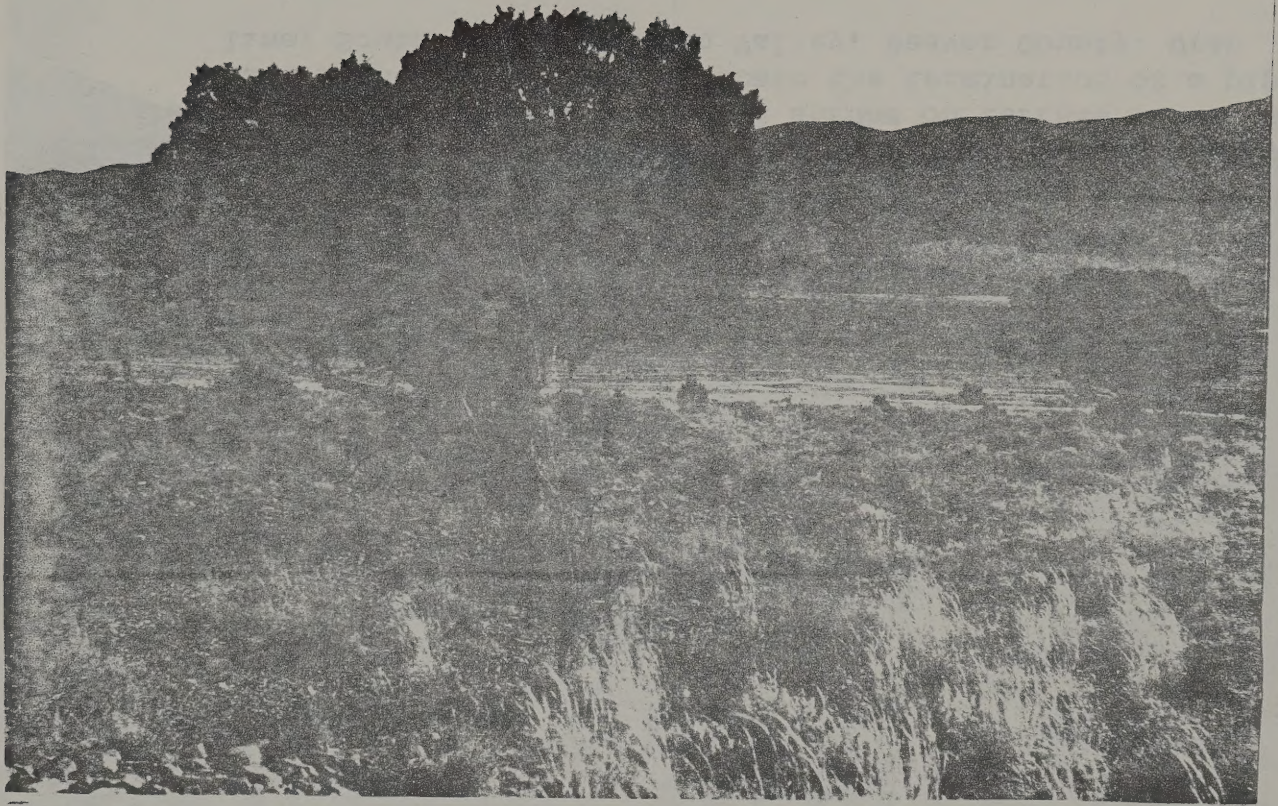


Fig. 25. A highlined juniper indicating severity of use by livestock. This could have occurred in a severe winter or by heavy use during long periods of grazing. The effect is usually rather permanent. North end of Pine Valley, Millard County, Utah.

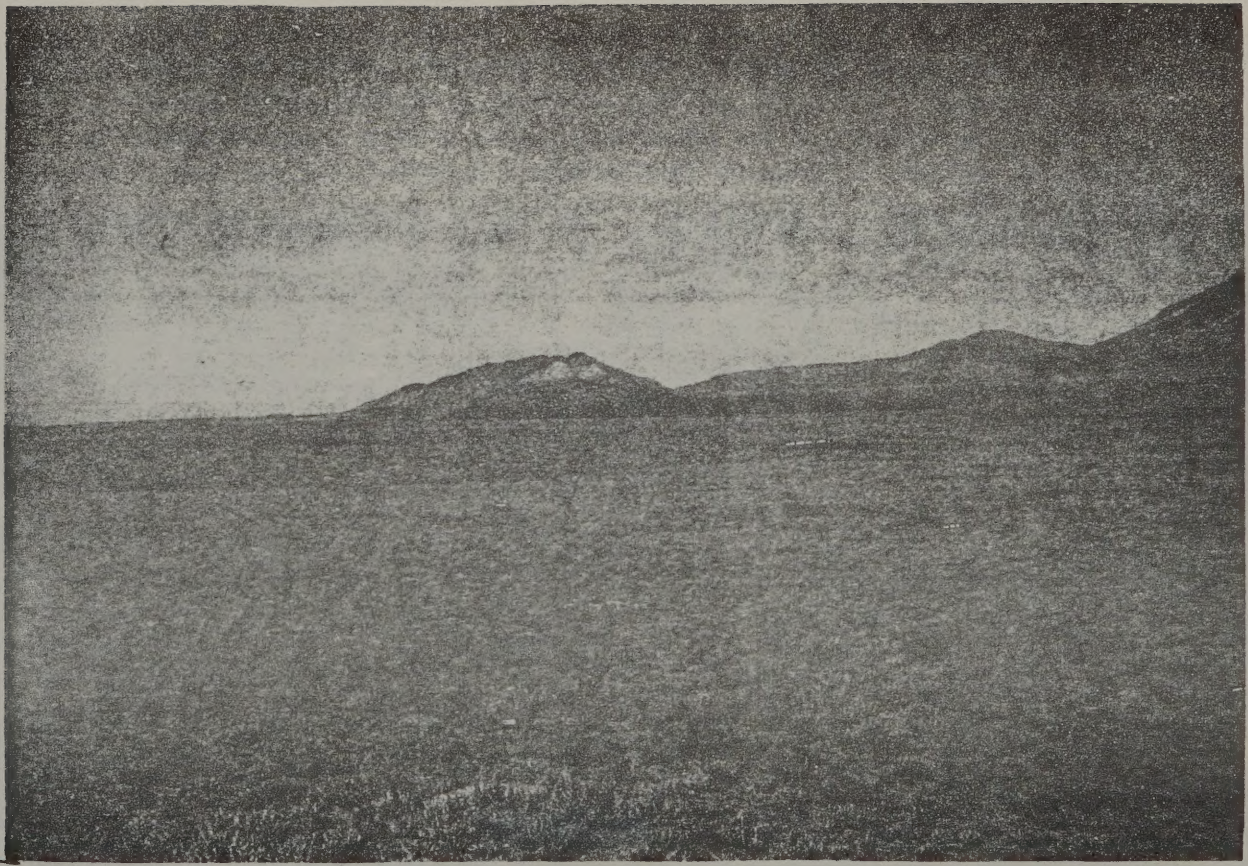


Fig. 26. Russian thistle and scattered shrubs on terrace of ancient Lake Bonneville. Trees indicate the termination of a pipeline. South end of Wah Wah Valley, Beaver County, Utah.

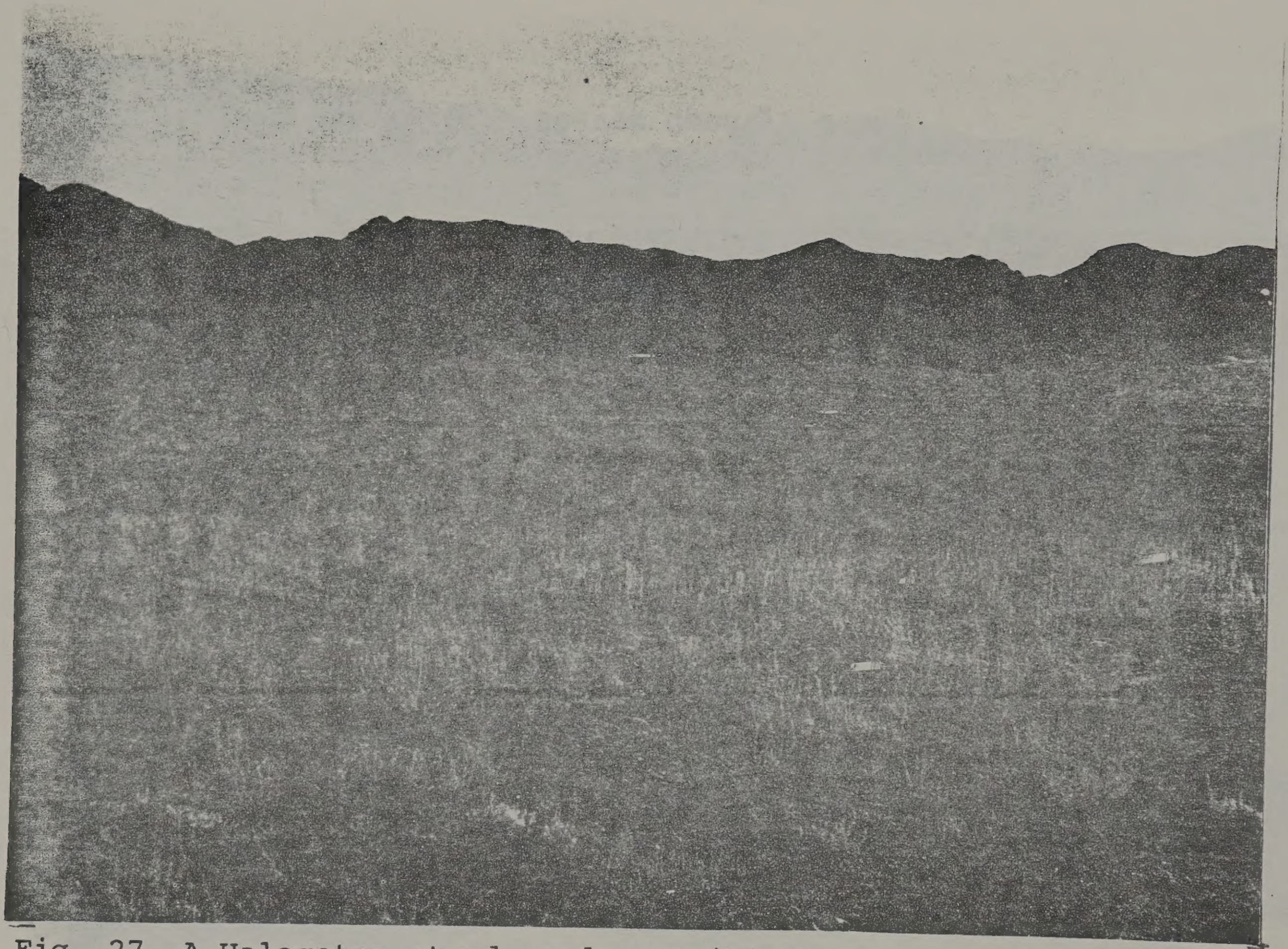


Fig. 27. A Halogeton stand, made possible by over-use of the more palatable species that previously occupied this area. BLM land. North end of Pine Valley, Millard County, Utah.

Fig. 28. Stockwatering pond and adjacent depleted land. Pipeline to Newhouse evident on right arid background. Wintch Ranch, Wah Wah Valley, Beaver County, Utah.

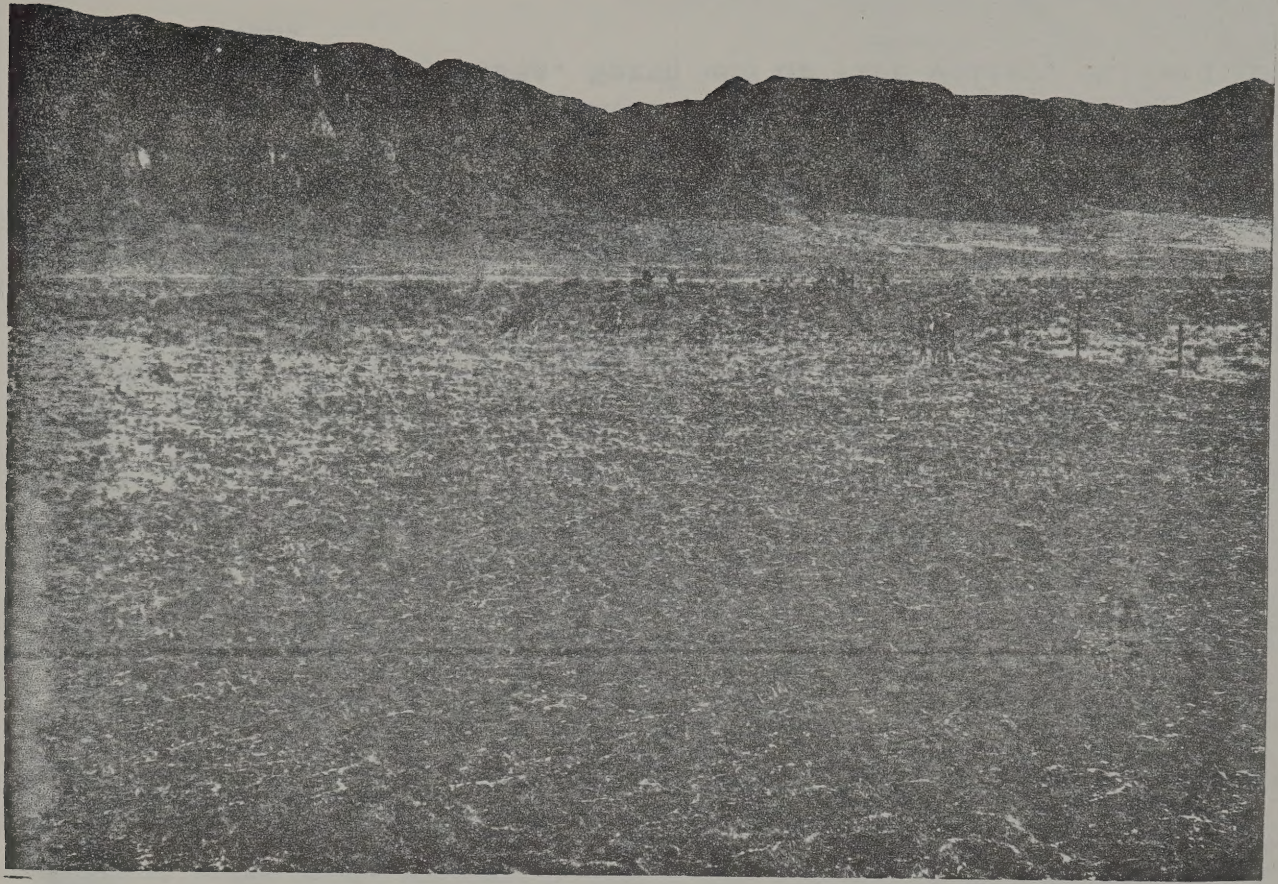


Fig. 29. Manure and vegetation devastation in corner of pasture. BLM land in North end of Pine Valley, Millard County, Utah.

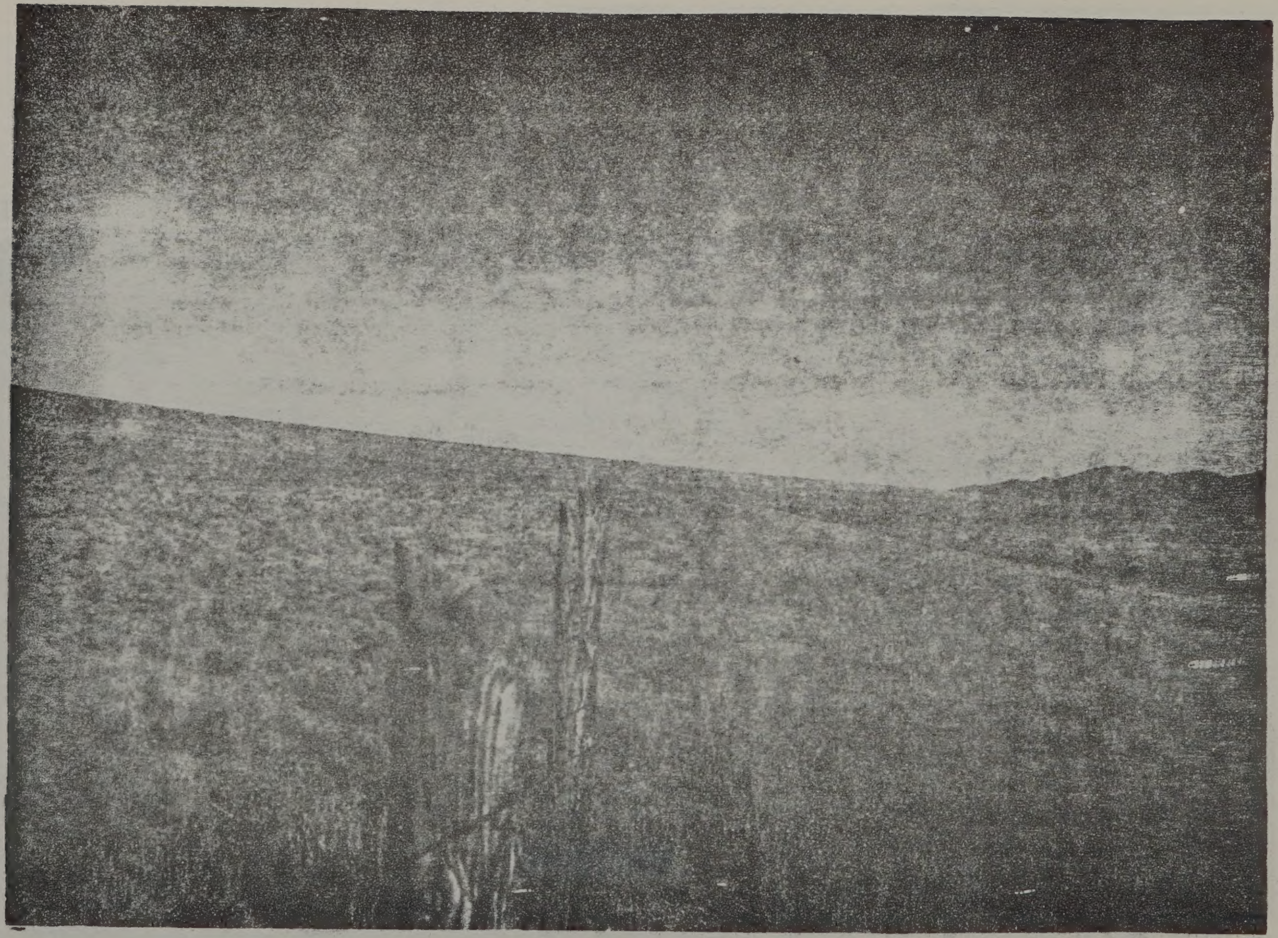


Fig. 30. Fence-line contrast. BLM land on right dominated by Halogeton. Desert Experimental Range on left dominated by native shrubs and grasses. North end of Pine Valley, Millard County, Utah.

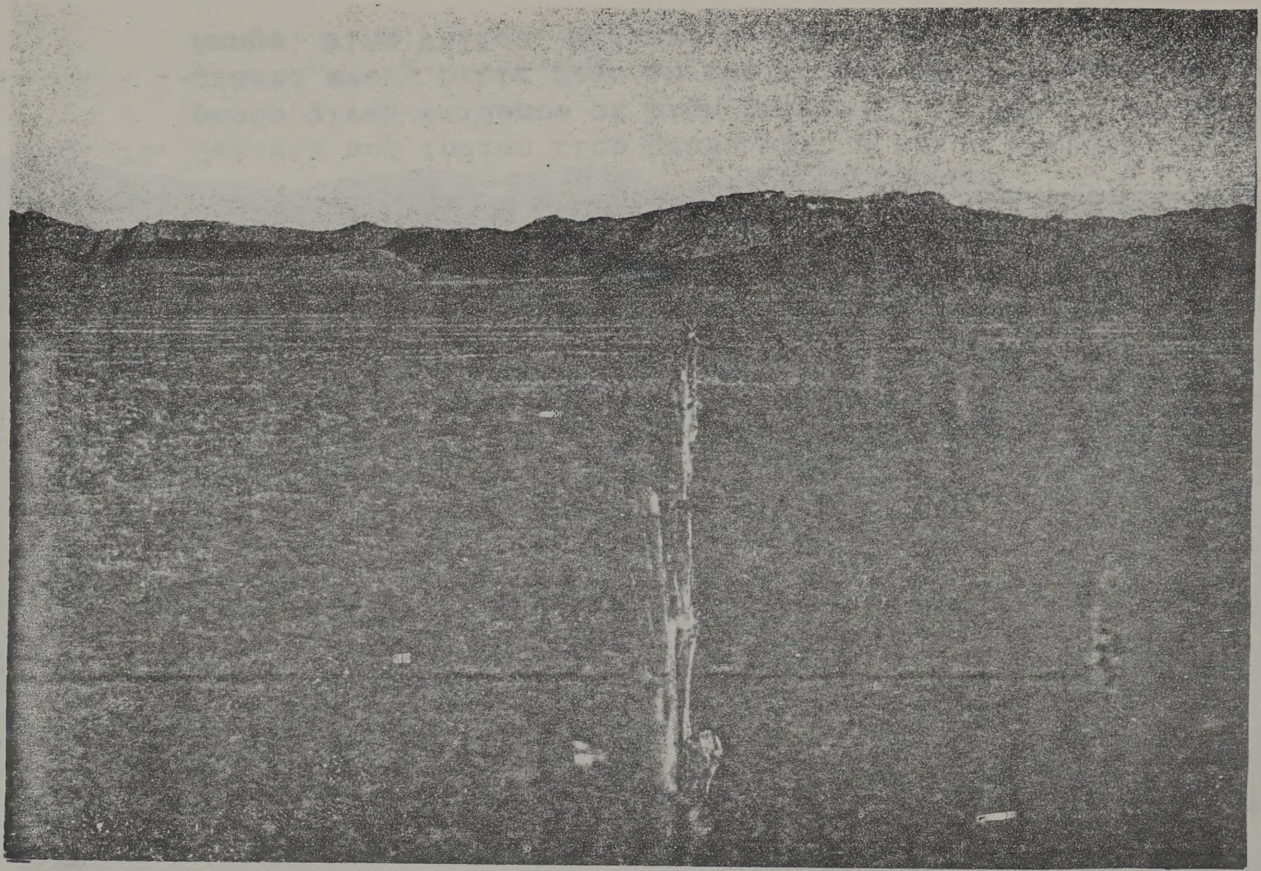


Fig. 31. BLM land on left of fence with unpalatable rabbitbrush as the dominant vegetation. Desert Exp. Range on right with highly preferred blacksage as dominant. Antelope Valley, Millard County, Utah.

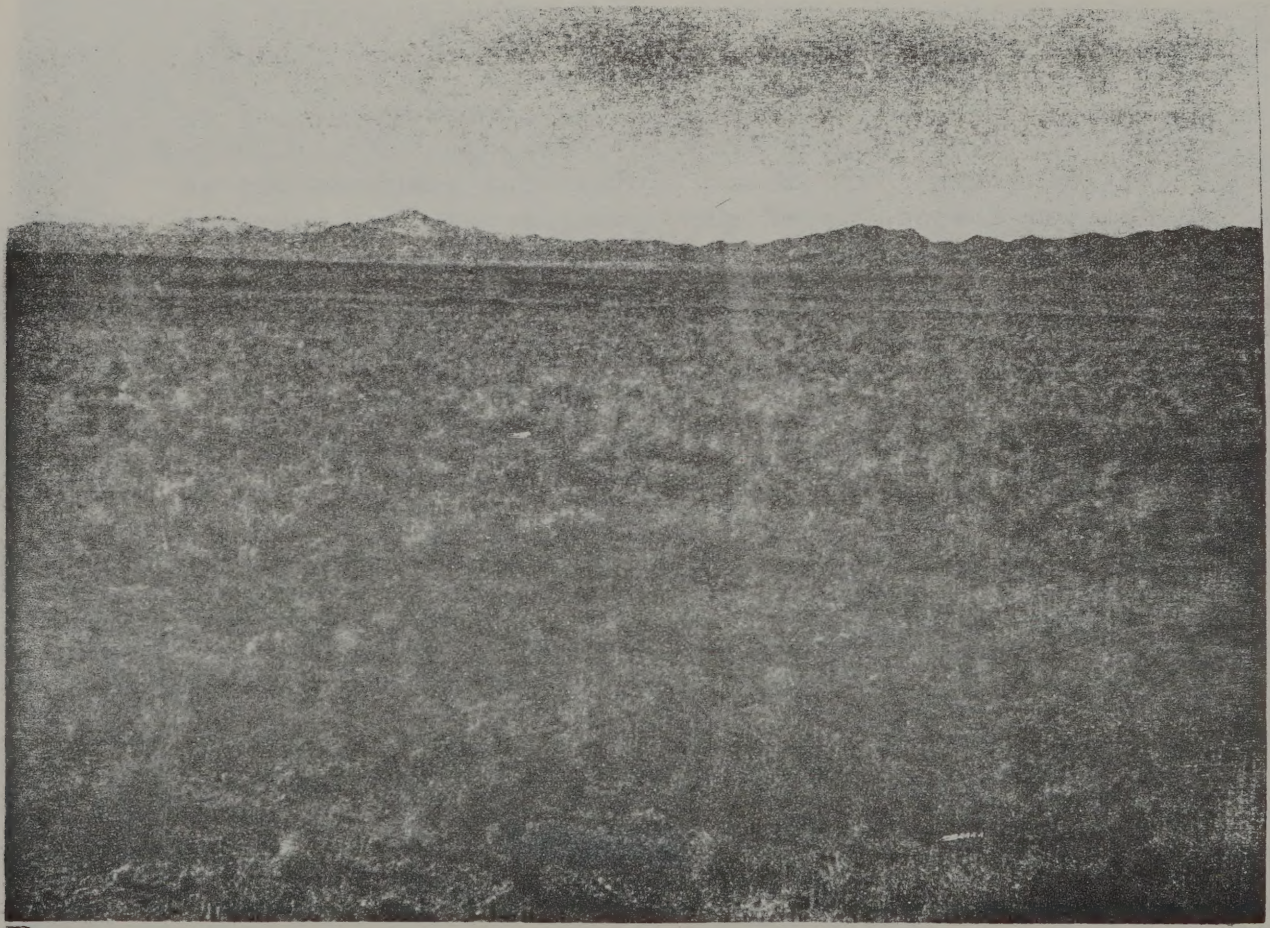


Fig. 32. Galleta and Indian rice grass with a shrub mixture. This photo gives evidence of high potential productivity where grazed every other year in the spring. Desert Experimental Range. Pine Valley, Millard County, Utah.

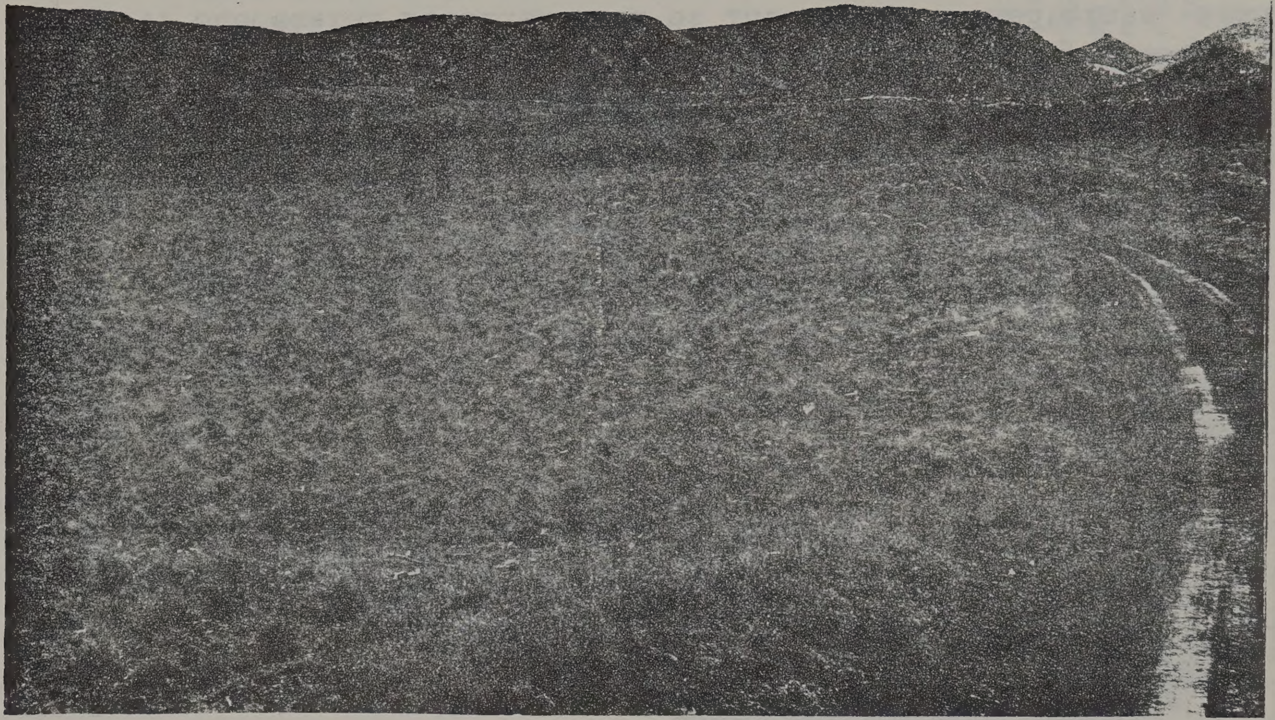


Fig. 33. Reseeding in cleared pinon-juniper woodland on BLM land. Useable forage increased 10 to 100 times. South end of Wah Wah Valley, Beaver County, Utah.

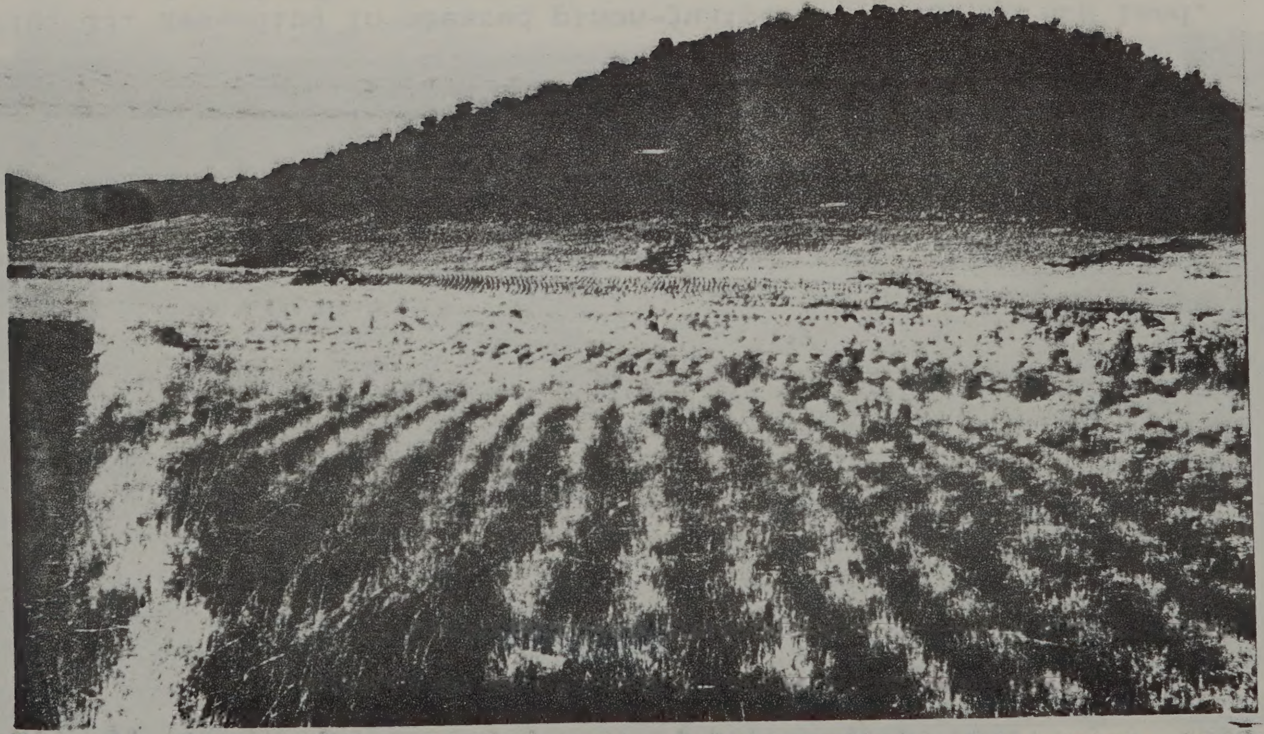


Fig. 34. Successful reseeded area of Intermediate wheatgrass. Seeds were drilled in after chaining, windrowing, and burning of trees. Non-cleared area provides cover for wild game. BLM land, south end of Pine Valley, Beaver County, Utah.

have been principally concerned with providing livestock with water. The development of watering troughs and storage tanks close to the water source and the practice of piping water to remote locations has resulted in making water less available for many wildlife species. Inasmuch as water development is the key to increase in numbers of antelope (and probably of other species as well), it would seem that provisions could be made for concurrent use of water by both wildlife and livestock (Fig. 35).

Federal, State and County agencies need to cooperate more closely to ensure ease of management and to ensure lack of cross-purposes. Laws to allow more free exchange of State School lands should be enacted. The 1870 Mining Laws should be modified to prevent destruction of Federal lands in the name of mineral exploration. Federal and state agencies should correlate predator and fur-bearing carnivore kill with rabbit and rodent populations and with changes in the vegetation resources which result as a consequence of carnivores killed.

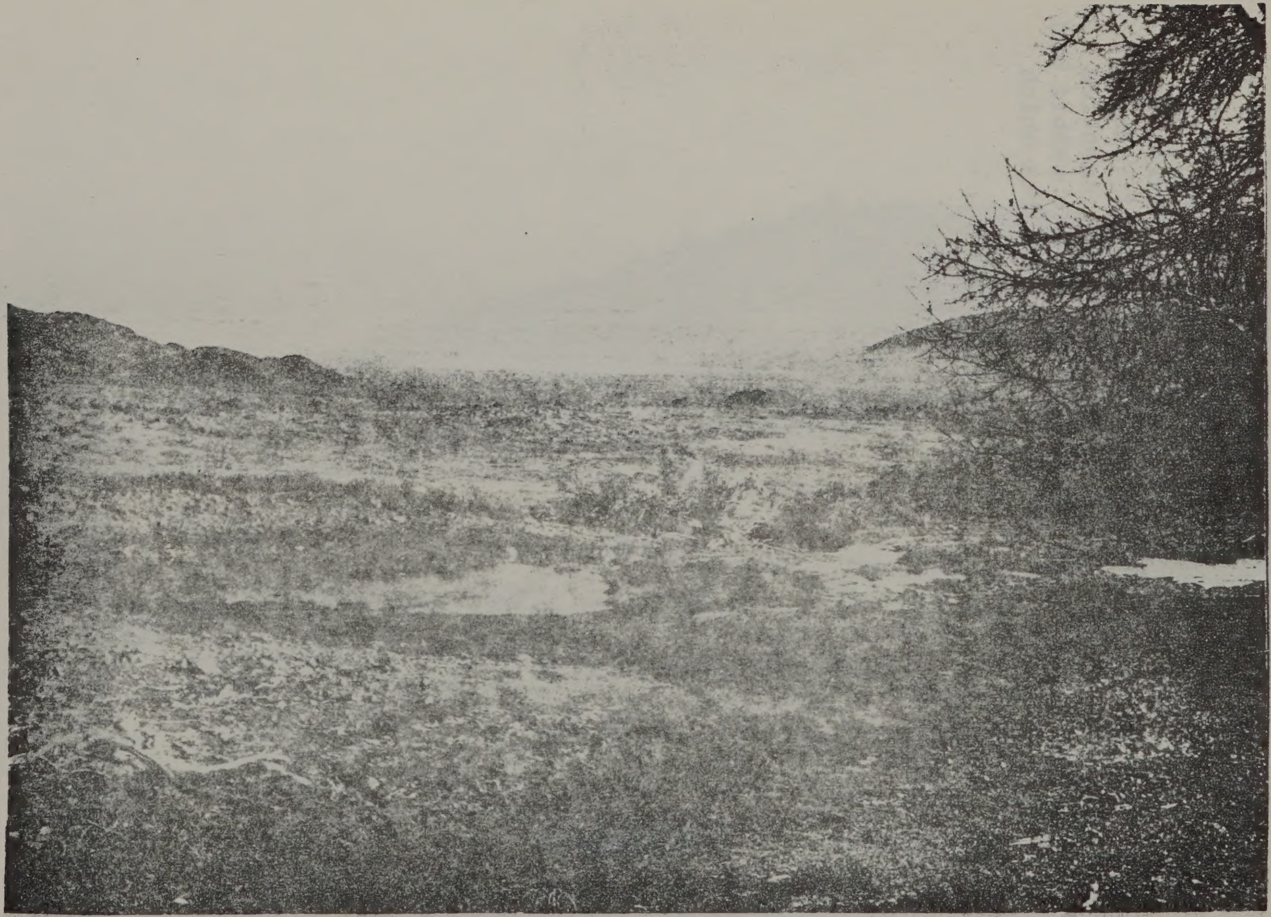


Fig. 35. Permanent pond available for use by both livestock and wildlife, near Wah Wah Spring. Wah Wah Valley, Beaver County, Utah.

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CASE STUDY NO. VII

CUTTING PRACTICES COMPOSITE

by

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Denver, Colorado

CHAPTER I

Introduction

The U.S. Forest Service is charged with the management of the National Forests for "multiple use." Although the concept of multiple use and its acceptance as Forest Service policy goes back to the earliest days of the Service, it was not articulated as a policy by Congress until the Multiple Use - Sustained Yield Act was passed in 1960 (Appendix B). Significant passages from that Act follow:

> It is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes.
>
> "Multiple Use" means the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some lands will be used for less than all the resources . . . not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output will meet the needs of the American people.

Our technical forestry science and practices, inherited from Europe, were developed for the production of wood products. The "silvicultural systems" developed for harvesting and reproducing forests included clearcutting. This traditional forestry adhered closely to ecological requirements of species and to preservation of the forest environment. It did not include multiple use, which is an American concept.

Early American foresters, following the European lead, at first favored silvicultural systems that removed only part of the stand. These systems, however, proved unsuitable for many western forest types and especially for converting even-aged old-growth stands to managed stands. Residual stands blew down, declined in vigor and suffered top-dieback, suffered accelerated damage from dwarf-mistletoes, and reproduced poorly under canopy. Many of our more valuable western species (Douglas fir, western white pine, lodgepole pine, ponderosa pine, redwood) are "fire-species." They were originally dominant over large areas only because fire renewed the stand periodically.

Foresters in the west turned to clearcutting in patches (Fig. 1), or strips (Fig. 2) (2,8). Size, distribution, location and density were

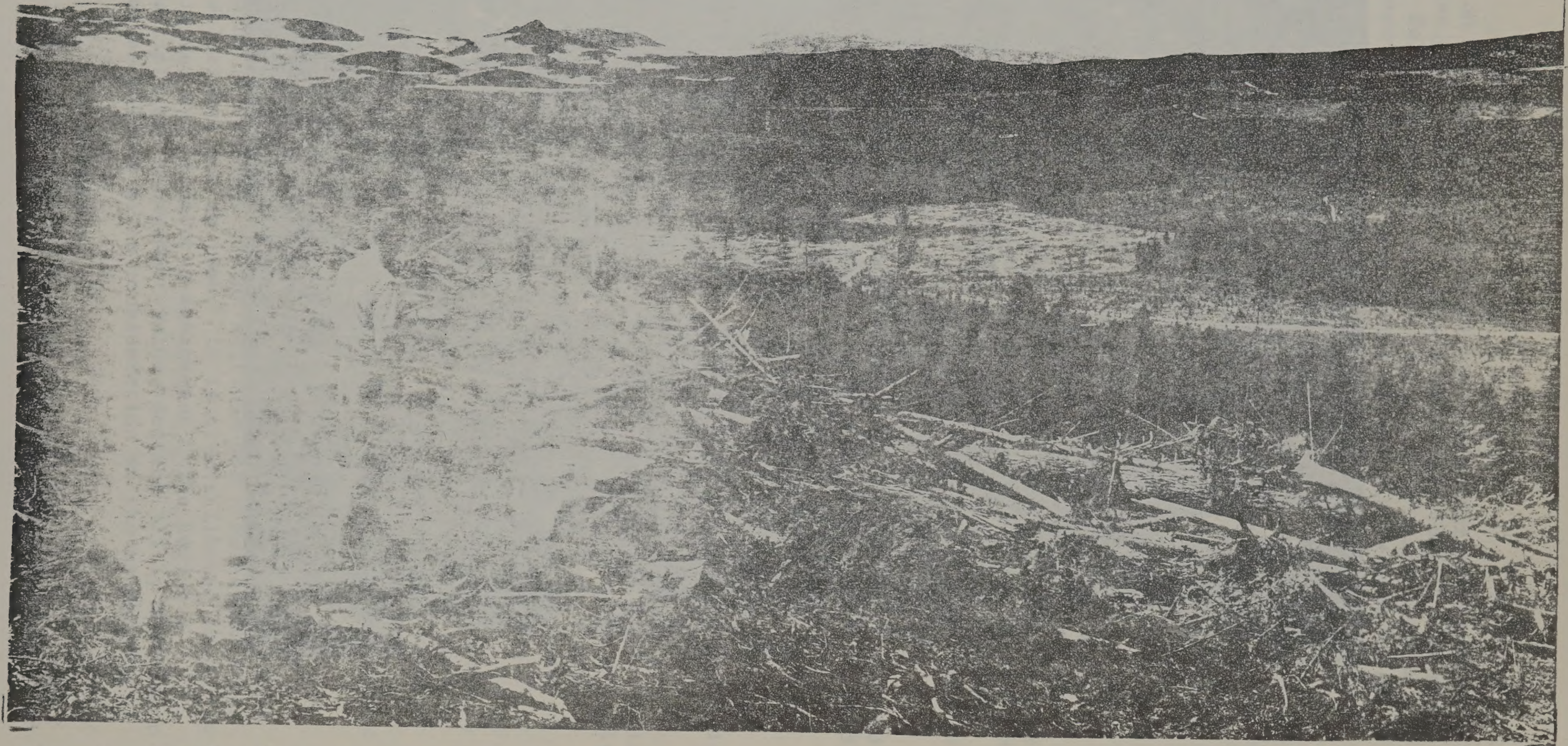

Fig. 1. Patch clearcutting in lodgepole pine. Lewis & Clark National Forest, Montana, U.S. Forest Service photo.

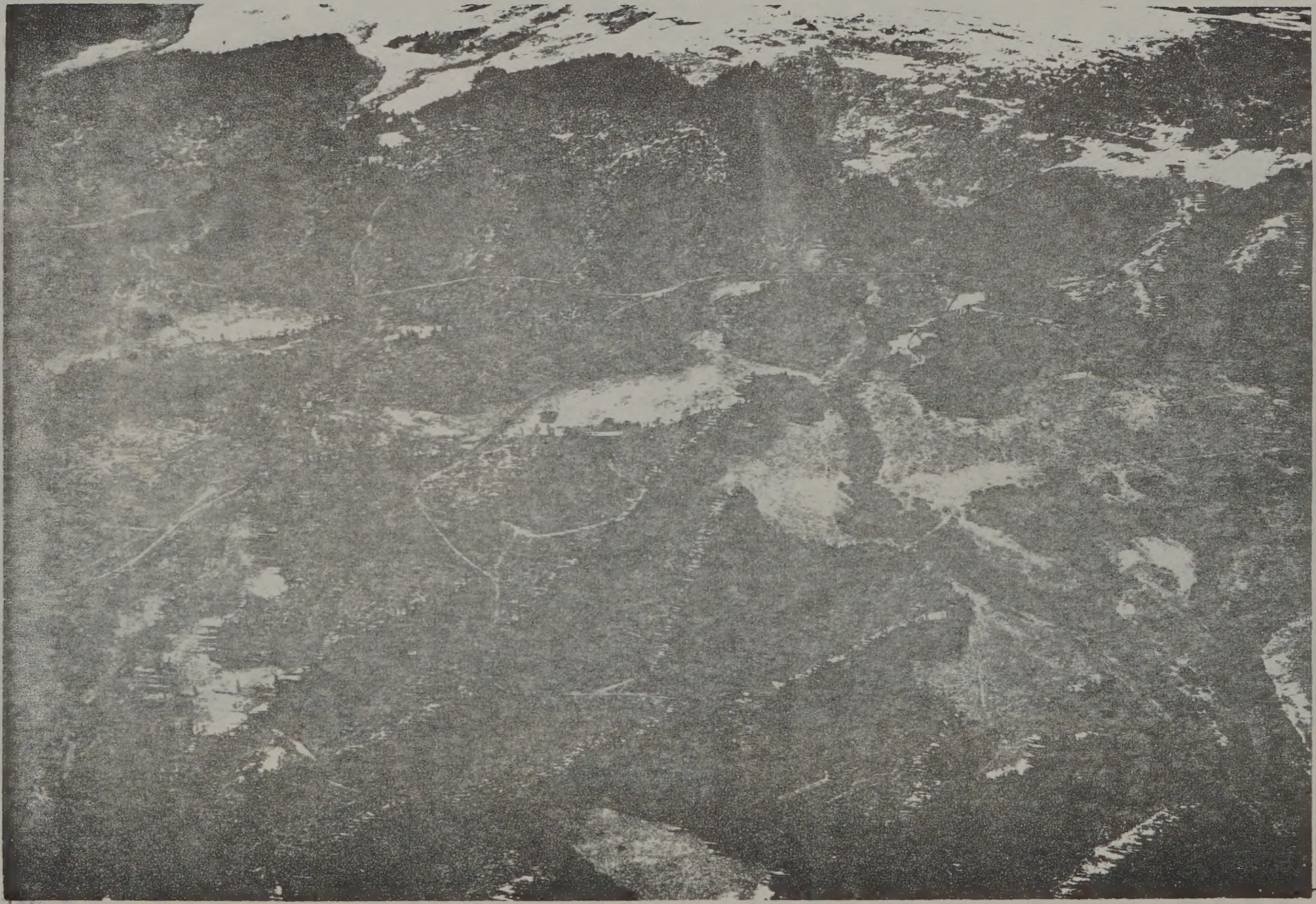

Fig. 2. Emergency clearcutting for bark beetle control, Fish Creek, Teton National Forest, Wyoming.

determined largely on the basis of reproduction requirements; protection from insects, disease, fire and wind (7,1) and efficient logging and road-building cost (2). Policy required careful attention to avoid erosion, soil damage and damage to streams. Aesthetics played little part in decisions at first, but cuttings were usually avoided in areas considered to be scenically sensitive, along highways and in areas considered to have high recreation potential.

Harvest cuttings accelerated rapidly after World War II. Forests at higher elevations and in remote locations were penetrated. Epidemics of tree-killing insects and hurricane damage stimulated emergency harvesting (Case Studies 2, 4, 5). Such hastily-planned projects sometimes turned out to be poor showcases of multiple-use forestry (Fig. 2).

As roads (many constructed initially for timber harvesting) opened up the forests, as the environment of our cities deteriorated and as the atmosphere and waters of the land became increasingly fouled, more and more people sought respite in the forests and mountains. They found the roads and cuttings displeasing and made their displeasures known (Chapter II, Case Studies 1, 2, 5). Many of these visitors were well-educated, knowledgeable in biology and aesthetics, and could articulate their complaints.

Roads and timber harvesting expanded further into previously unroaded areas, some of them de facto wildernesses (Chapter II, Cast Studies 1, 2, 5). Outdoor recreationists, nature lovers and preservationists, becoming increasingly aware of the shrinking area of wilderness, organized opposition (Chapter II, Case Studies 1, 2, 5).

Concern with the quality of the environment grew; the highest official in the land, the President, offered leadership. Outdoor and conservation-oriented groups grew in numbers and activity. They leagued together and developed an effective lobby in Washington capitalizing on the growing public concern about environmental pollution within the wasteland of our metropolitan centers. Local groups interested in local environmental problems found they did not have to fight their battles alone. The national clubs and federations assumed their causes (Chapter II, Case Studies 1, 2, 5).

Foresters in general, and the Forest Service in particular, found some of their road building and logging practices opposed by these groups. This came as a shock to foresters; they had led the conservation movement for years. They were still conservationists. But large-scale timber harvesting had partially separated the groups even though they still shared many interests and goals.

The Forest Service and other land-management agencies sensed the changing public demands concerning the public forests and responded. This concern was reflected by the passage of the Multiple Use - Sustained Yield Act in 1960 and the Wilderness Act in 1964. It is also reflected in policy statements on multiple use and wilderness management. The Region 2 (Denver, Colorado) Multiple Use Management Guide, Section 323.3, Recreation 1 states: "esthetic values will be given consideration in the management of all resources, occupancy, and use." Judge Kent (Western Michigan Federal District Court) ruled in the recent Sylvania litigation that the Multiple Use - Sustained Yield Act is mandatory, and the Forest Service does not have the administrative discretion to omit "due consideration" of any values affected by projects on the National Forest. 1/

However, the national needs for wood products were growing continuously, and the Forest Service was trying to carry out its policy of marketing its allowable cut under sustained-yield principles to the wood products industry. To meet this need, Congress increased funds for timber sales administration. The National Forests were staffed to carry out that assignment with foresters skilled for that purpose. So, although Forest Service policy required balanced consideration of all uses, emphasis was on those uses and activities that were most fully financed. The unfinanced or inadequately financed activities probably received lesser consideration.

The situation in the last few years has been complicated by the current personnel ceilings and economy moves in the federal government.

> The means discussed on how the increased timber job could be done within present ceilings and appropriations as well as the deliberations as to what programs could be curtailed to meet the impact of the increased timber cut is a case in point. I believe this to be a definite indication of our inability to fully redeem our responsibility for total resource administration of the National Forests under present limitation. 2/
>
> National Forests in Region 1 are not funded to develop or manage any of the resources at 100 percent of potential nor to fund special skill needs at 100 percent level. 3/

The result has been conflicts in the interests of National Forest users. On one extreme is the wilderness lover; wilderness cannot be compromised or it is no longer wilderness. On the other extreme is the commercial timber harvester. Of all the forest uses, clearcutting has the greatest impact on wilderness and scenic values.

1/ Gandt v. Hardin, W.D. Mich., Civil Action No. 1334, December 11, 1969.

2/ Letter from John S. Forman, U.S. Forest Service, Region 6, Portland, Oregon.

3/ Letter from Neal Rahm, Regional Forester, Missoula, Montana.

ENVIRONMENTAL IMPACT

Clearcutting and roadbuilding make strong impacts on air quality, soils, water yield, water quality, aquatic environment, wilderness values, wildlife, vegetative patterns, scenic resources and recreation resources.

(1) Air Quality is affected only when logging slash is burned, usually in the fall of the year. In the past, the burning has meant weeks of smokey atmosphere in the West Coast states. In view of threatened legislation prohibiting it, Forest Service research has developed guidelines for burning under atmospheric conditions that carry the smoke high into the atmosphere and away from populated areas (4). On the Teton and Bridger National Forests, slash is burned only during seasons when there are few visitors.

(2) Soils damage depends on when and how logging is done and on the attention given soil characteristics in road building. Logging on wet soils, especially with tractors, compacts the soil, and skid trails tend to serve as drainages. Logging on dry soils has little lasting effect. Cable logging, especially uphill logging that lifts the logs, or the skyline or balloon logging that carry the logs entirely in the air, has little damaging effect. Logging of any kind can accelerate soil erosion. The impact depends on the kind of soil, method of logging, steepness of slopes and post-logging treatments, but if operations are properly planned, erosion need not be serious (6).

(3) Water Yield is typically increased by logging. In snow country the increase comes in the spring run-off (Chapter II, Case Study 3). Where pricipitation comes as seasonal rain, as on the West Coast, most of the increase comes as run-off during storms. The greater run-off increases potential flood crests, and much logging debris can be carried downstream causing temporary logjams and considerable damage to bridges and populated areas.

(4) Water Quality and the Aquatic Environment are affected in several ways. If the shade is removed from live streams, water temperatures increase. Increased water temperatures can change the stream ecology adversely for salmon and trout. If shade is left, temperatures change little (5).

Organic debris in streams causes heavy oxygen demands that may deplete the water's dissolved oxygen and prove lethal to aquatic life. Protective strips along the banks of live streams can prevent logging slash and debris from entering the stream.

Soil erosion may deposit silt in the stream, which can make streams unsuitable for spawning of salmon and trout and destroy valuable water-inhabiting insects that are the prime food for salmonids. Decaying vegetative matter can change the chemical purity of mountain streams. Nutrient enrichment coupled with increased light and water temperature can induce abundant algal growth.

Most of the changes in stream quality can be minimized by appropriate measures to protect the streams during road building and logging.

(5) Wilderness values are essentially destroyed. Roads and logging are incompatable with wilderness.

(6) Wildlife habitat may be improved or damaged. Habitat for most game animals and some ground-dwelling game birds is improved by creating openings in a dense coniferous forest. Deer and especially elk may be driven away at least temporarily, by logging activities. Possibly they could be permanently discouraged from returning if heavy logging slash is not cleaned up. At the Fraser Experimental Forest in Colorado, use of the logging areas by both deer and elk increased over pre-logging levels only after the slash was broken down by winter storms (Chapter II, Case Study 3). Elk are essentially wilderness animals and tend to leave ranges where roads receive continuing traffic (Chapter II, Case Study 2).

(7) Vegetative Patterns and Scenic Resources receive the greatest impacts and have been the focus of many recent controversies. (Chapter II, Case Studies 1, 2, 5)

Vegetative patterns are always changed by clearcutting and often on a long-range basis. The impact onscenic values depends on the nature of the changes and the individual who is viewing them. Brock Evans of the Sierra Club has stated that he never saw any cutting that improved a forest landscape (Chapter II, Case Study 5), an opinion shared by others who have special appreciation of the characteristics of wilderness (Case Study 1).

The professional analysis is expressed as follows: 4/

> The forest may be considered by area of view, foreground, middleground and background. Management practices which reduce logging slash; improve utilization; reduce erosion; take advantage of recreation opportunities; or in some manner reduce the adverse visual impact of logging and road building, apply equally to all view areas (Fig. 1).
>
> Any picture or scene is composed of . . . elements of design /which/ include: color, tone, form, shape, and texture. In various combinations these elements can create any degree of contrast, balance, unity or visual movement depending upon light conditions and relative position of the observer.
>
> When applied to what might be considered typical patch-cut units, we see that there is usually a tremendous contrast created between the units and the background. This is because of the distinct difference

---

4/ Barnes, 1969

> in color, tone, and texture; and because the shape of the units accents these differences by restricting them within a more or less symmetrical boundary. There is little opportunity for smooth visual movement. Your eye seems to be held on these contrasting spots--jumping from one to another (Figs. 3, 4, 5).
>
> To be good, design has to indicate function as well as have visual appeal (Fig. 6). To the observer, individual units scattered over the mountainside represent a hit-and-miss type of management, as though we have more timber resource than we know what to do. . . .

To improve visual impact Barnes proposes planned pattern harvest cutting as a way to tie clearcut units together visually, creating a balanced, unified pattern which compliments the natural landscape (Figs. 5, 7). The pattern may be designed in such a manner that it neutralizes timber harvest and accents prominent scenic features (Fig. 5). This is accomplished by forming part of the pattern in the direction of the scenic attraction so that the eye moves naturally through the pattern to the focal point.

> The pattern may also be designed to create its own interest in the ordinary landscape, where scenic attractions are often lacking. Here again form is the controlling design element. The pattern should repeat and tie into natural forms, thus reducing contrast by creating unity. That is, the pattern should fit the landscape.
>
> As the initial pattern is developed and continues to grow, the rawness of new units will be less and less apparent to the observer because the perimeter of the pattern will become greater and greater. Thus a given pattern will be a dynamic thing continually changing within itself, always expanding. [5]

PROBLEM ORIGINS

On the surface the conflict is between traditional forestry and the amenities between utilitarian and non-utilitarian use of the forests.

Traditional forestry is rooted in road building and clearcutting practices which were determined in large measure by economics, engineering and silvicultural considerations. The amenities were short-changed.

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[5] *Ibid*.

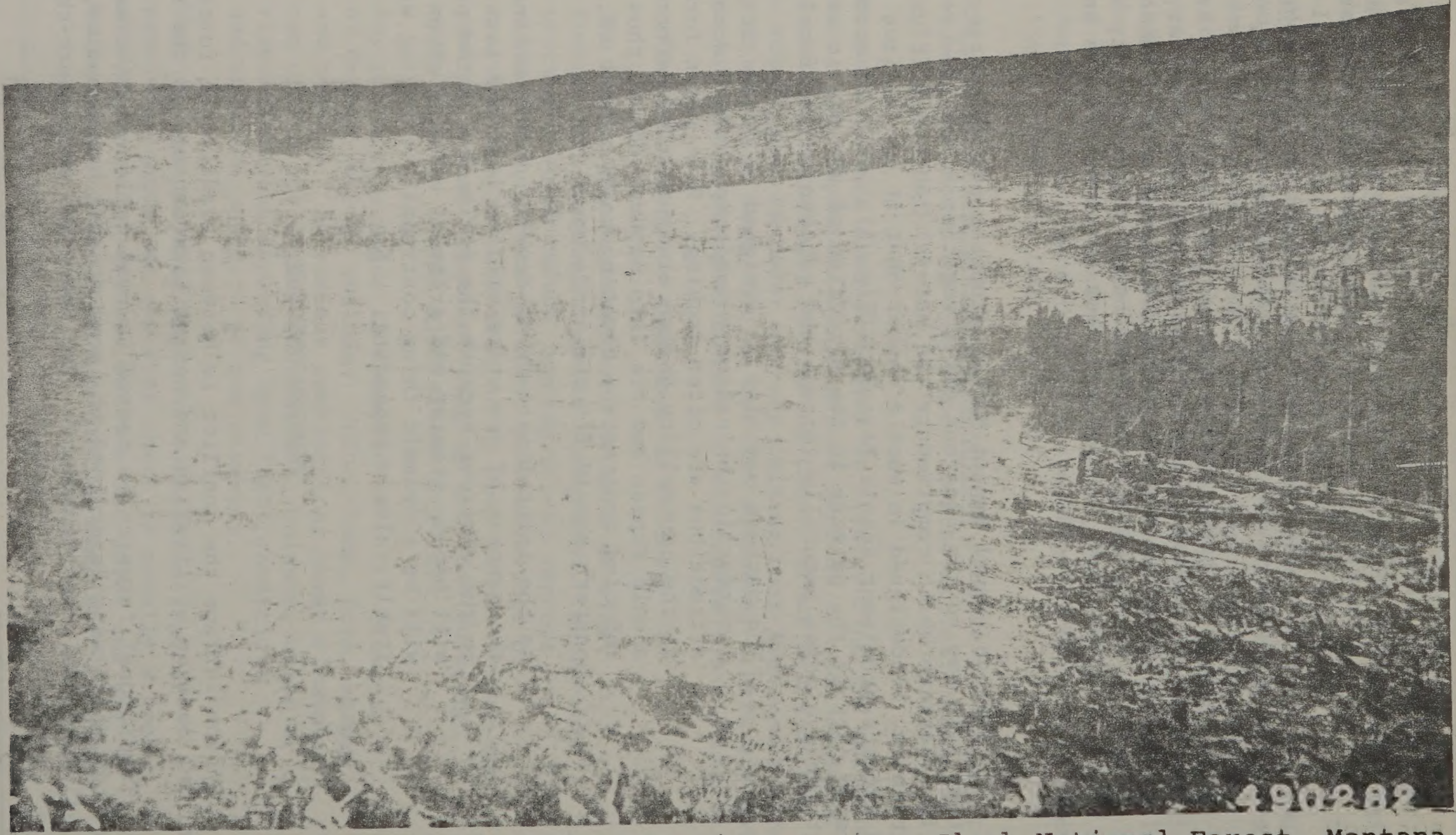

Fig. 3. Patch clearcutting in lodgepole pine. Lewis & Clark National Forest, Montana.
U.S. Forest Service photo.

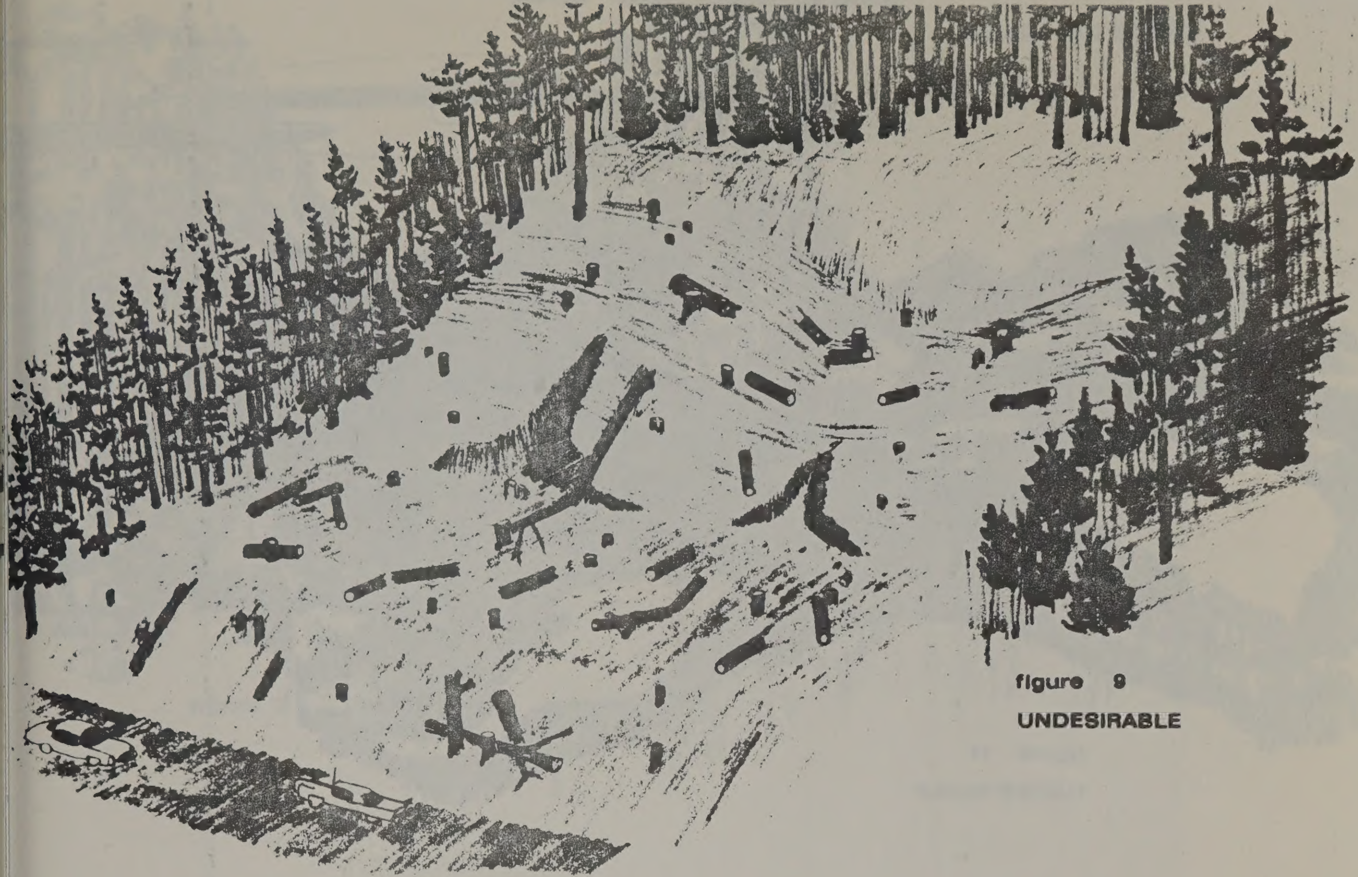

figure 9

UNDESIRABLE

CUTTING TO MAINTAIN
LANDSCAPE VALUES
IN WHITE AND RED FIR

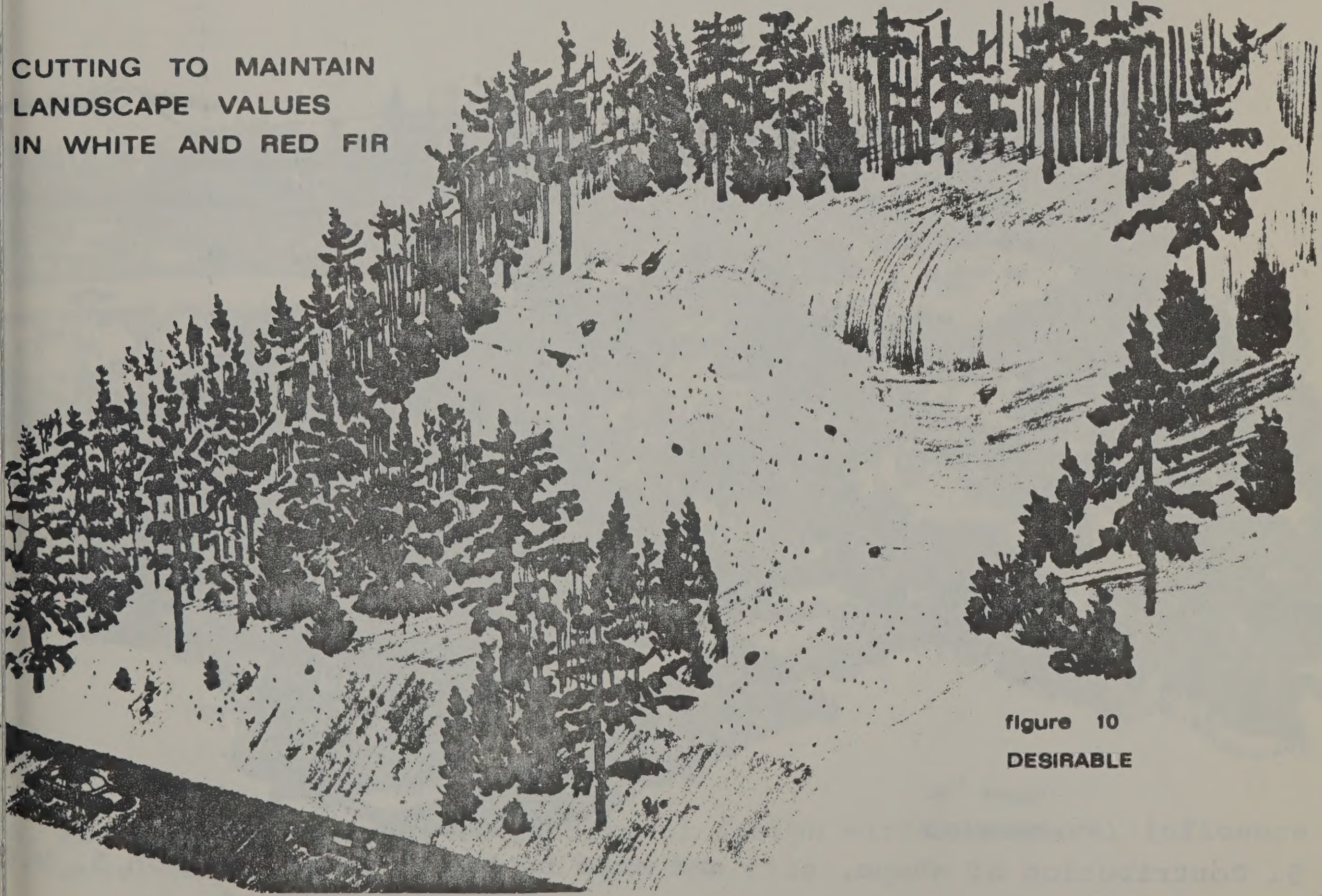

figure 10

DESIRABLE

ig. 4. Cutting to maintain landscape values in white and red fir. Region 5, U.S. Forest Service photo.

SHAPE, SIZE, AND EDGE

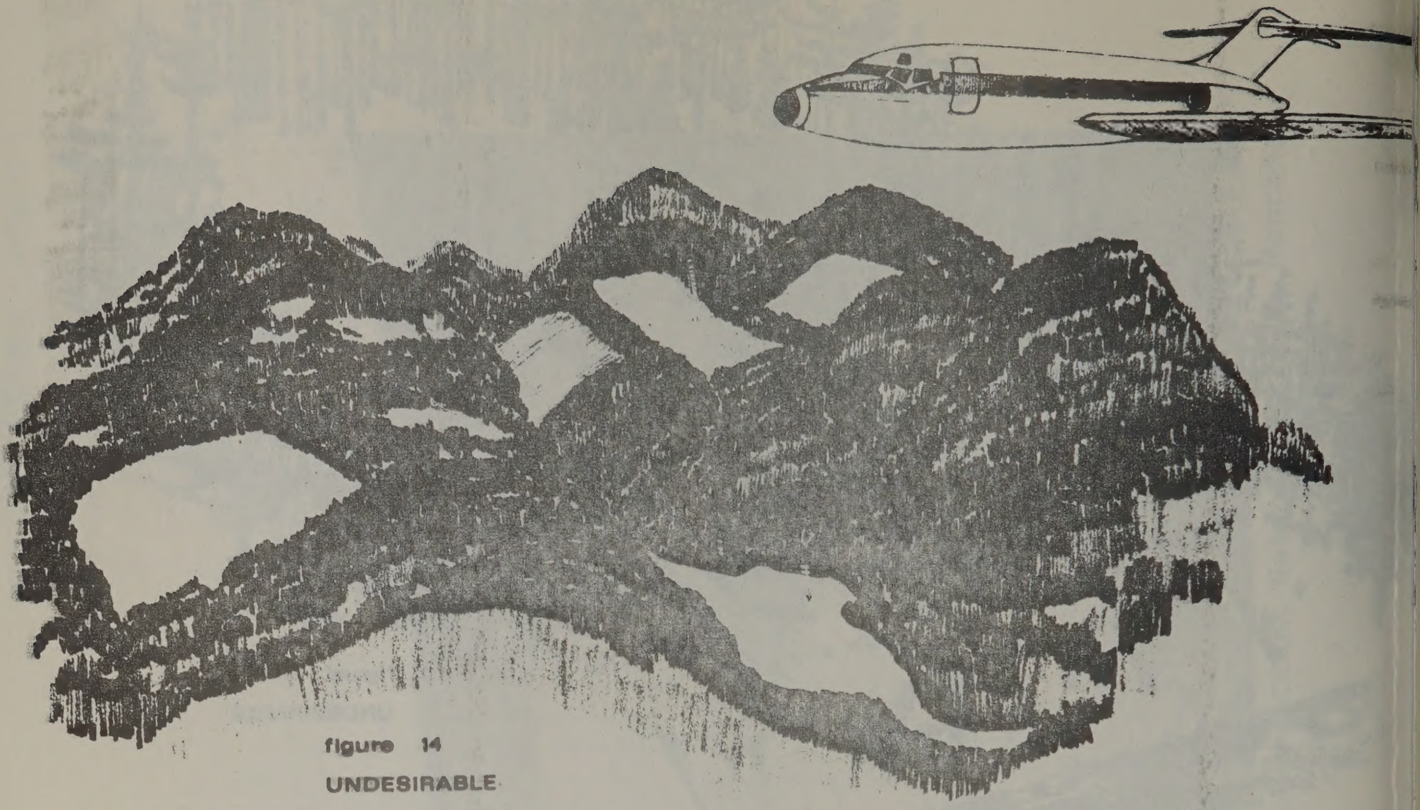

figure 14

UNDESIRABLE

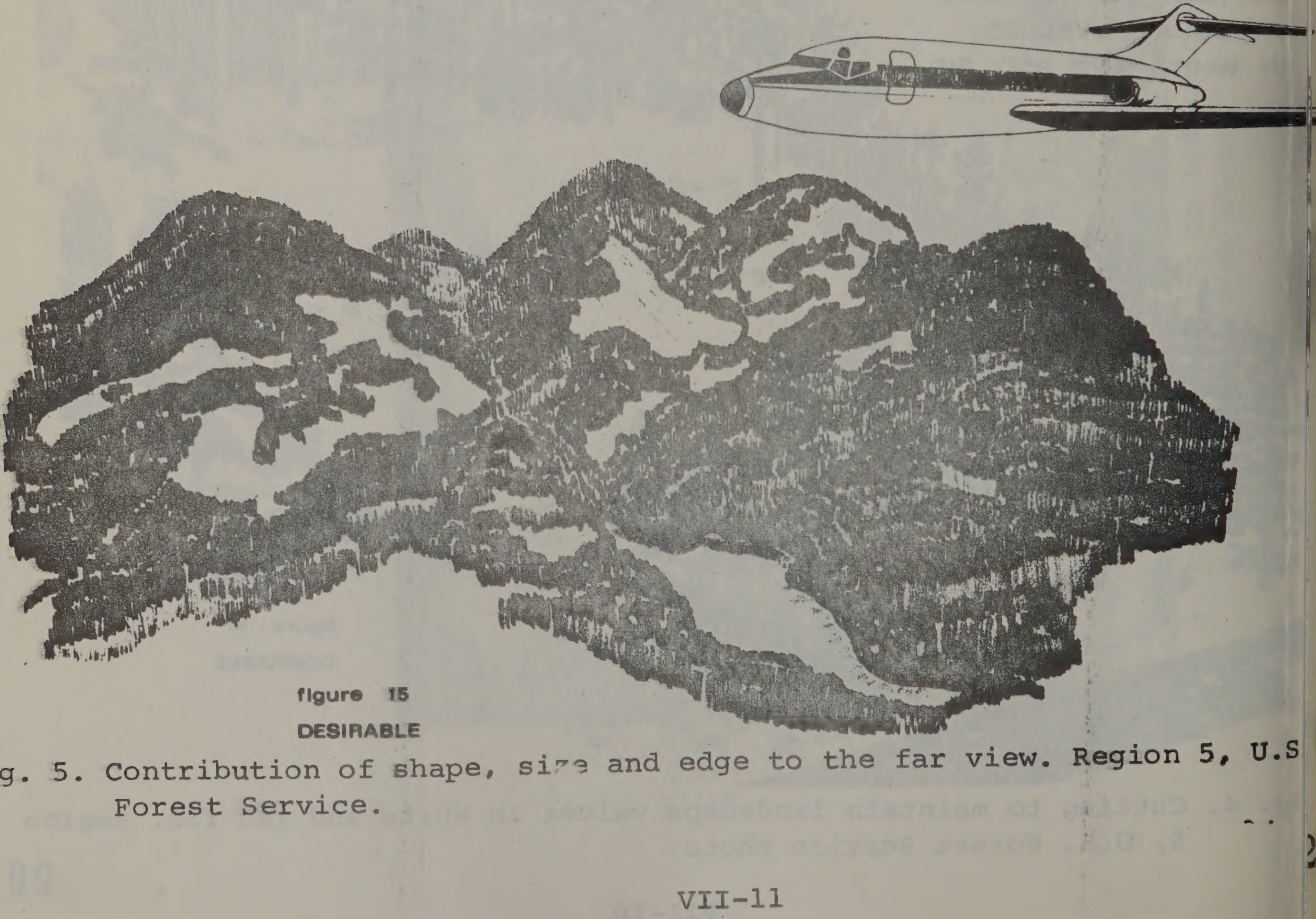

figure 15

DESIRABLE

Fig. 5. Contribution of shape, size and edge to the far view. Region 5, U.S Forest Service.

AND INTEREST

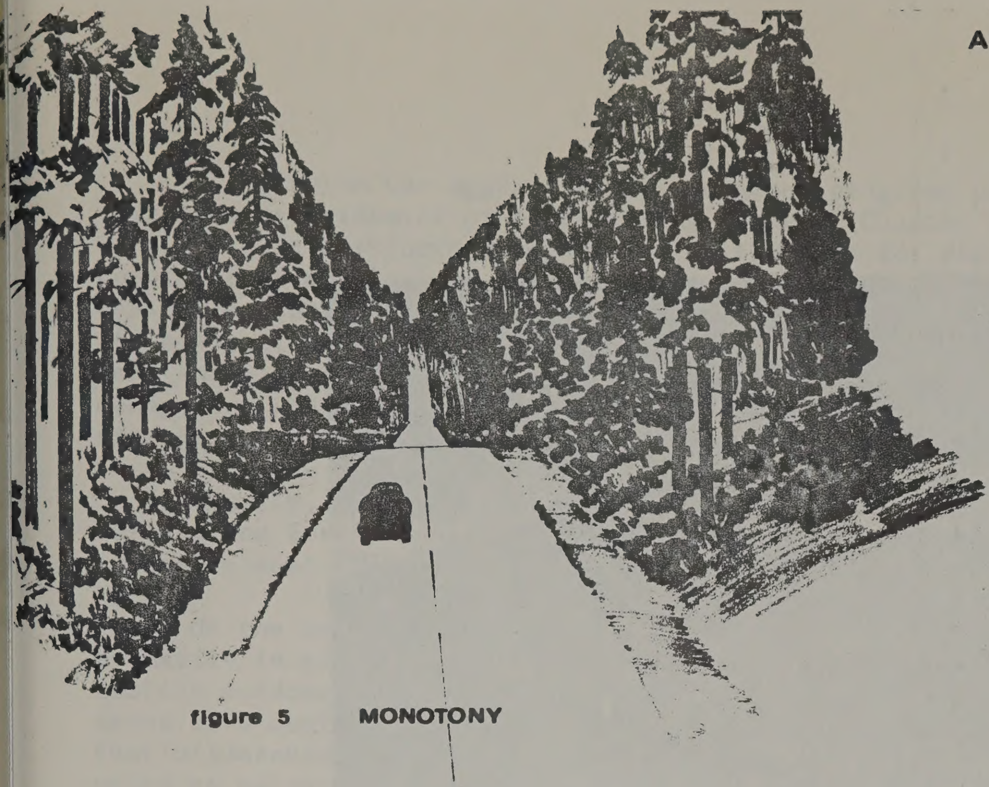

figure 5 **MONOTONY**

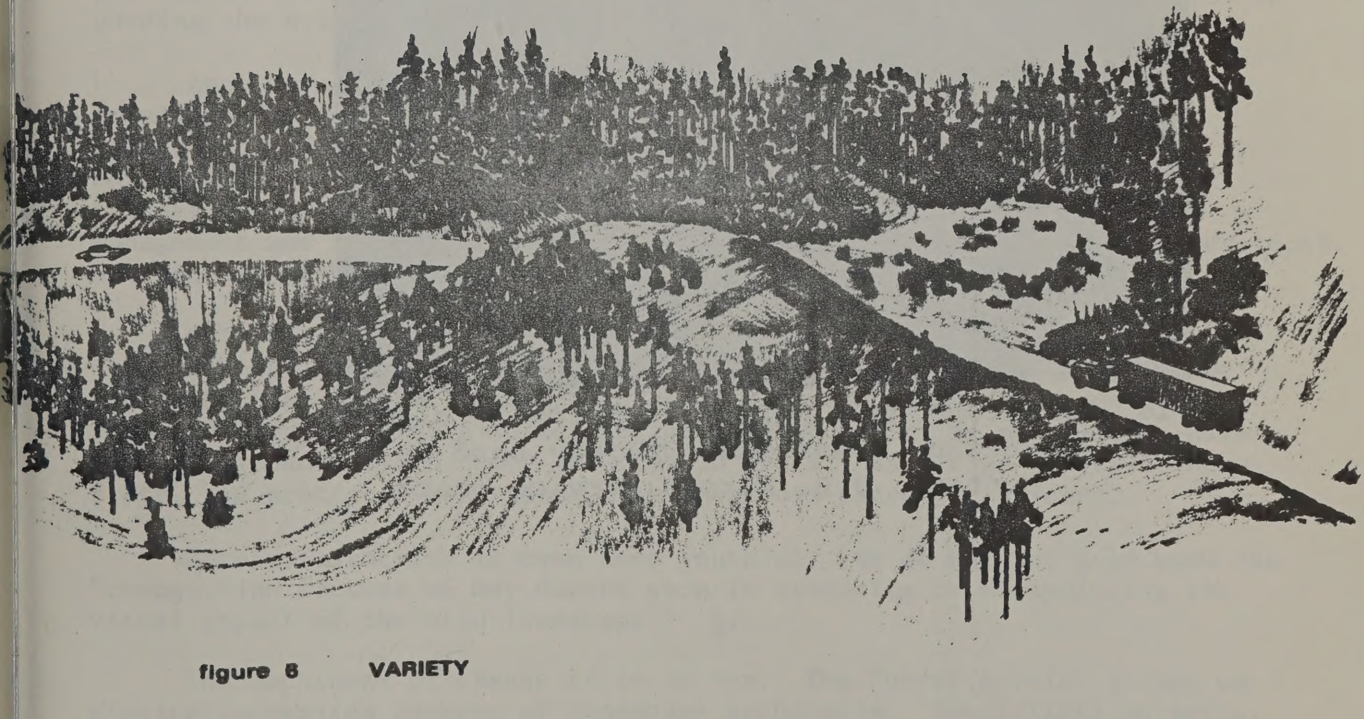

figure 6 **VARIETY**

.6. Monotony and variety in functional design within a travel influence zone. Region 5, U.S. Forest Service.

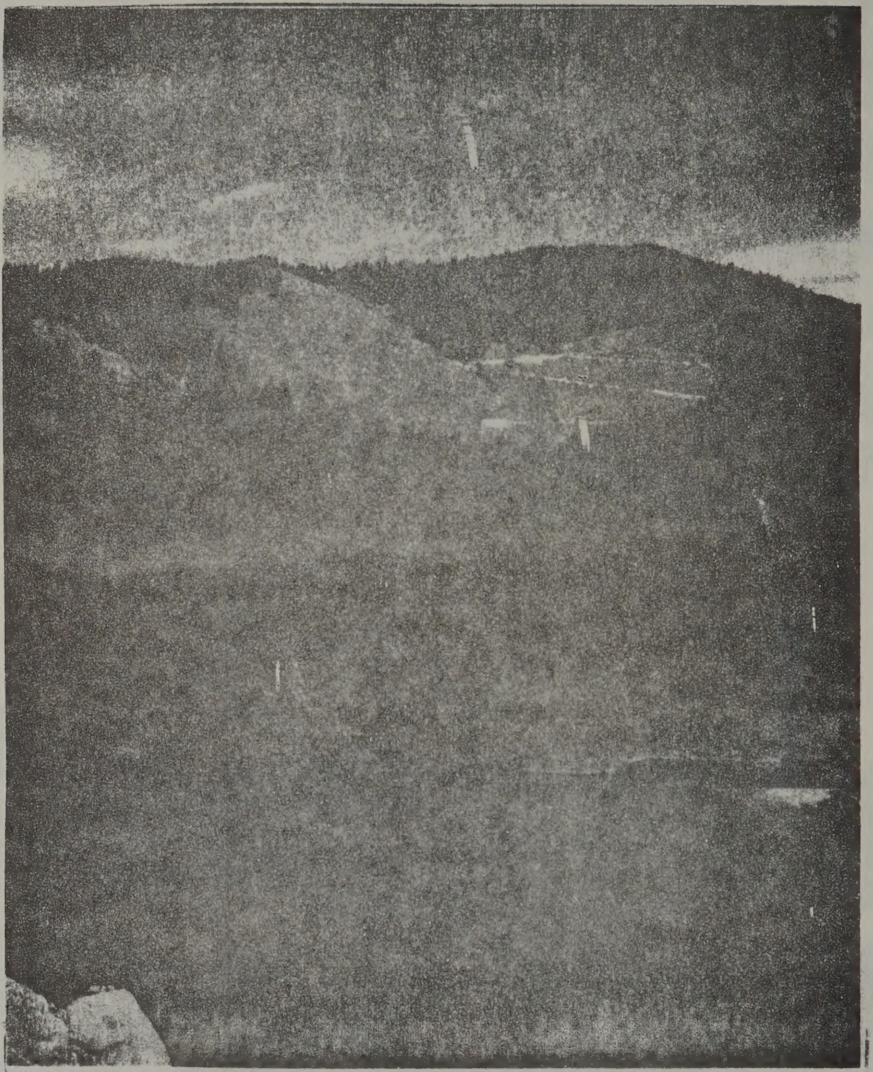

Fig. 7. Extending a natural opening by clear-cutting. Anaconda Company Land in Montana. U.S. Forest Service photo.

The problem was aggravated by emergency programs of timber harvesting triggered by epidemics of tree-killing insects (Chapter II, Case Studies 2, 4, 5). It was further aggravated by the need for timber to bear the cost of road development, which sometimes leads to heavier cutting than desirable (Chapter II, Case Study 2). Contributing also are the financing and accounting procedures of government. Funds are appropriated to the land managing agencies for specific purposes. Activities like timber management and recreation are financed. But aesthetics is not. Any expense incurred for aesthetics must come from funds of a financed activity.

Finally, foresters traditionally receive thorough grounding in silviculture and forest management in their training. They are likely to emphasize most the activities that they are trained to do best.

On the opposing side of many controversies are users who are interested primarily in protection and improvement of environment, natural beauty, quality outdoor recreation and preservation of wilderness. Some of this group have characteristics that contribute to the problem: (1) an attitude that wilderness cannot be compromised, that there is no middle-ground in which to bargain; (2) a desire to obtain vested interests in the people's forest (Chapter II, Case Study 5); (3) narrow views and closed minds, especially among some new enthusiasts of wilderness.

On the other hand, leaders of the movements are well informed regarding all resource values. For example, they made helpful suggestions regarding the Bridger controversy (Chapter II, Case Study 5).

Another element in the problem is the state of our knowledge of amenities forestry. Thirty years ago a few schools of forestry began curricula in fish and wildlife management. Recreation management was hardly known. Watershed management was just a part of ecology or silviculture. Today, curricula in forest recreation, in fish and wildlife management and in watershed management are widely available and well-developed. But forest aesthetics and forest landscaping are still in infancy.

Multiple-use forestry and wilderness are new American concepts. They were not included in the body of organized knowledge of forestry we inherited from Europe. Our knowledge of watershed management and recreation forestry, and to a lesser degree fish and wildlife management, have been developed only in about the last 30 years. Knowledge is still incomplete, and practical experience with these new concepts is scant.

Forest aesthetics is even more youthful. We do not yet even know the "recognition factors we may depend upon in assessing or manipulating the visual impact of the wild landscape." 6/

The machinery of change is in action. The Forest Service is now employing increasing numbers of landscape architects. Specialists in soils, watershed management and wildlife have been on the staffs for some time (Table 1).

6/ Litton, R. Burton, personal correspondence.

TABLE 1

EMPLOYMENT IN ENVIRONMENT-ORIENTED SPECIALTIES
U. S. FOREST SERVICE, REGIONS 1, 5 and 6
(Dec. 18-19, 1969)

Region 1	National Forests	Regional Office	Total
Landscape architects	6	5	11
Hydrologists/watershed	8	2	10
Wildlife positions	8	4	12
Wildlife biology education	9	-	9
Wildlife & Forestry educations	13	-	13
Region 6			
Soil scientists	8	3	11
Watershed specialists	13	2	15
Wildlife biologists	20	2	22
Fish biologists	1	1	2

Region 5	Grade G.S. 7-9	G.S. 11-13	Total
Landscape architects	10	12	22
Soil scientists	10	3	13
Hydrologists	5	11	16
Wildlife biologists	5	8	13

ENVIRONMENTAL CONSIDERATION

Until recently, most timber harvesting projects were planned around silvicultural needs, efficient logging and engineering feasibility, with consideration for soil stability, water quality and preventing soil damage. Established wilderness areas were respected, but there was little demand to safeguard aesthetics and foresters generally lacked the skills to do so. An exception was the insect control-salvage cuttings which involved only light selective cuttings (Case Study 4). Aesthetics and public safety were primary objectives of those cuttings.

The adoption of multiple-use planning in the early 1960's brought increased attention and dissatisfaction to environmental considerations, even though established attitudes and practices, costs of making changes and lack of environmental skills have slowed the process. The Ranger District Multiple Use Plan and multiple-use impact surveys are considered important tools. A multiple-use Plan, kept up to date by periodic revision, contains resource management decisions based on consideration of all resources and analysis of the most recent and reliable data. Multiple-use impact surveys are used to study the potential impact of timber sales and other proposed actions on significant resources and values. Having made use of these tools, and striving for a balanced and acceptable development of all resources, Forest Service people sometimes resist those who seek single-use.

The Forest Service is using multiple-use planning to gain balanced consideration of all environmental factors. This has led to more special studies, field investigations, public hearings, and coordination with other agencies, especially in areas where controversy has developed. Some examples follow:

(1) Multiple Use Impact studies of proposed cuttings on the Willamette, Teton, Bridger and three National Forests in Southern California (Chapter II, Case Studies 1, 2, 4 and 5).

(2) Special management plans for the French Pete Drainage and the West Side of the Wind River Range (Chapter II, Case Studies 1, 5).

(3) Soil erosion and stability studies in the Teton and Bridger National Forests (Chapter II, Case Studies 2 and 5).

(4) Hydrological studies, potential damage to the watershed and streams on the Bridger National Forest (Chapter II, Case Study 5).

(5) Fishery impact study in cooperation with Oregon Game Commission, Willamette National Forest (Chapter II, Cast Study 1).

(6) Wildlife impact study made by the Wyoming Wildlife Federation on the Bridger National Forest (Chapter II, Case Study 5).

(7) Special field reviews of conditions and proposed plans for all interested segments of the public and for leaders of national conservation organizations (Willamette, Teton and Bridger National Forests) (Chapter II, Case Studies 1, 2, and 5).

(8) Public hearings (Teton and Bridger National Forests (Chapter II, Case Studies 2 and 5).

(9) Appointment of a special Ad Hoc Committee of citizens to review the French Pete Case (Chapter II, Cast Study 1).

(10) Coordination with State Game and Fish Commissions (Willamette and Teton National Forests), and with the National Park Service and National Elk Refuge (Teton National Forest) (Chapter II, Case Studies 1, 2 and 5).

We believe that much progress has been made toward considering all resources, particularly in applying principles of landscape architecture to clearcutting practices (Figs. 7-10). The evidence is in the Multiple Use Management Plans and in the case studies that follow.

ALTERNATIVES

Exercising hindsight, the Forest Service may have minimized some problems by making complete multiple-use plans earlier; plans that gave balanced consideration to all resources, products and uses. There were no legal nor policy obstacles to such action.

But controversy appears to have been and to remain inevitable. The Forest Service manages the people's forests for the people, but the people's wants and needs are in an especially rapid state of flux. The combination of uses and products that best meets the needs of the whole people today may be different tomorrow.

Furthermore, the forests serve different segments of the public in different ways. Some uses are not compatible with others. Harvesting of wood products conflicts with wilderness and near-wilderness uses and aesthetics, bringing conflict.

Recognizing that it probably cannot avoid controversy, the Forest Service might pursue two objectives:

(1) Continue to try to determine the combination of uses that will most nearly neet the needs of the whole people both today and in the future, recognizing the long-term impact of activities such as timber harvesting.

(2) Learn to conduct each activity so it will have least conflict with other activities.

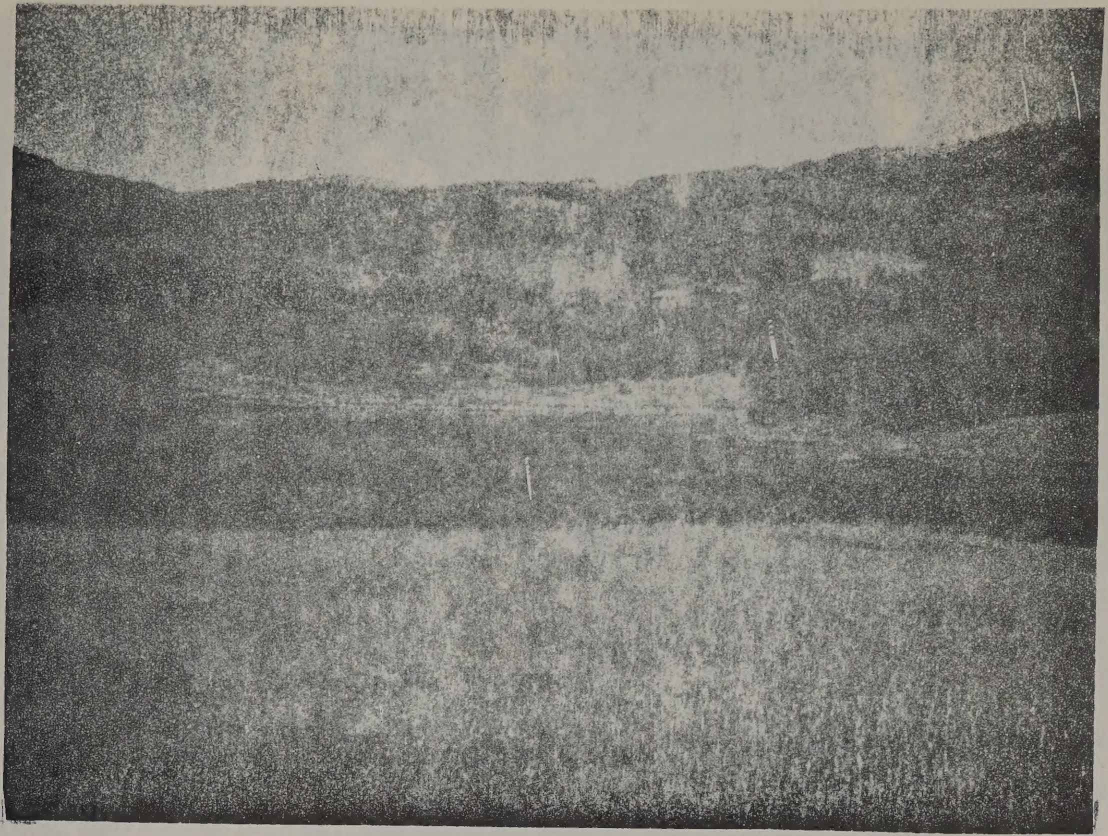

Fig. 8. A well-designed cutting (single cutting in middle background) complements the natural landscape. U.S. Forest Service photo.

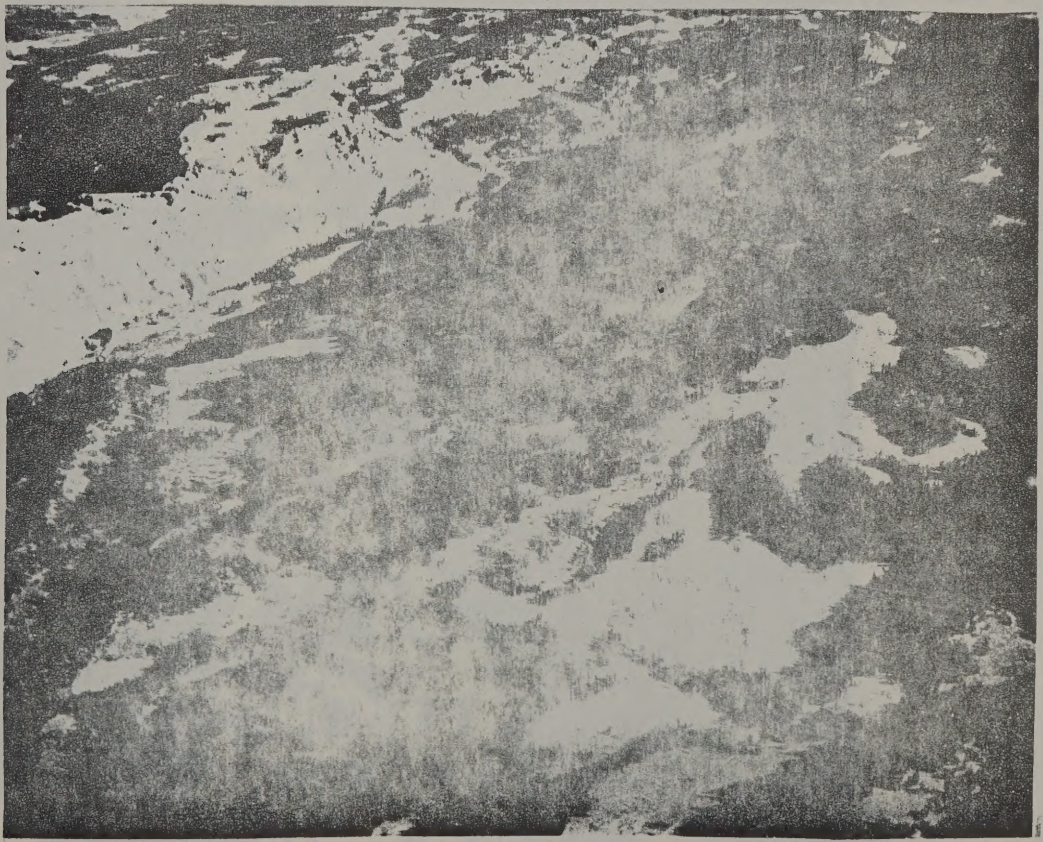

Fig. 9. These clearcuttings blend well with surroundings. Teton National Forest, Wyoming. U.S. Forest Service photo.

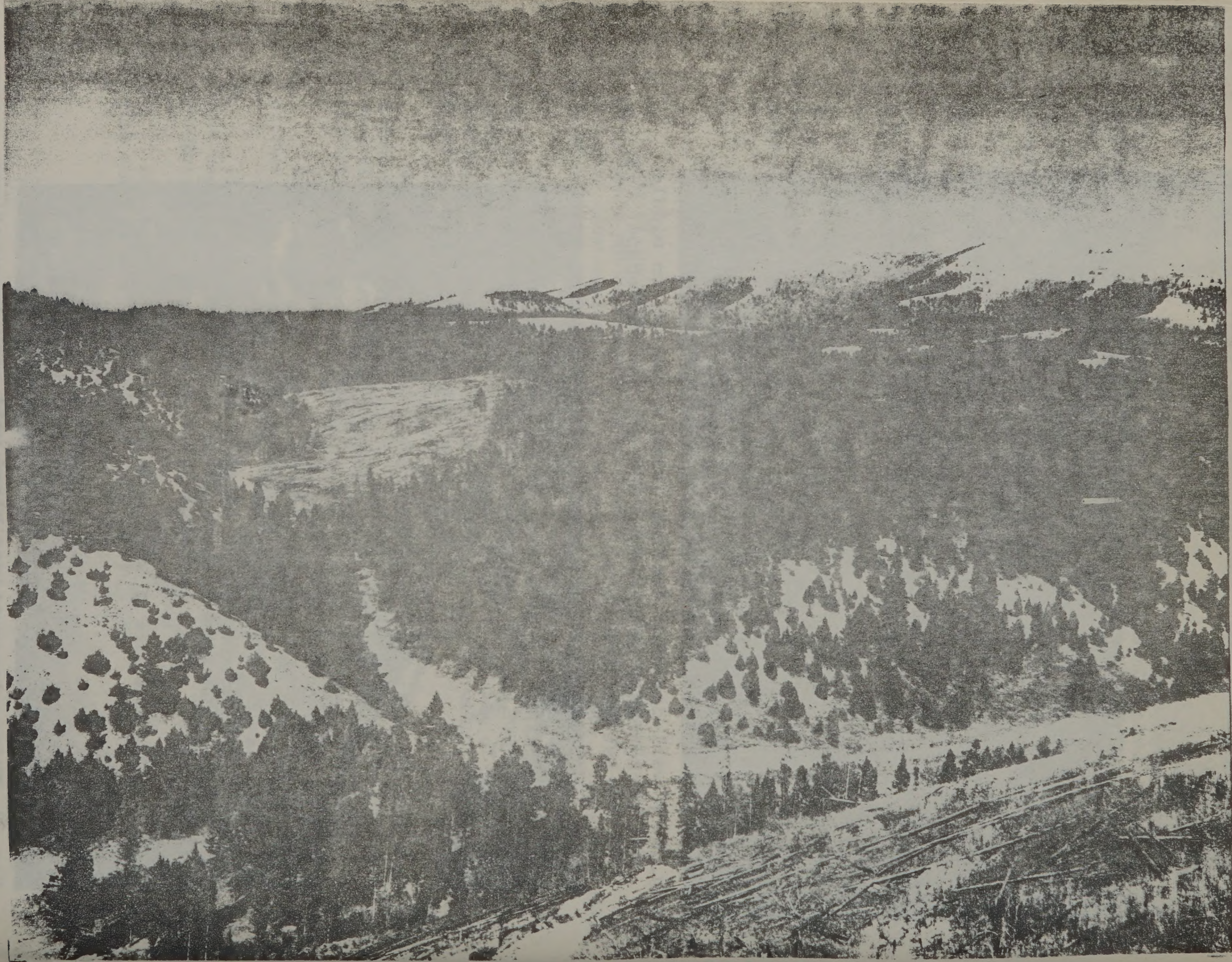

Fig. 10. This irregular cutting unit provides a link between the sparse forest on the left and the natural openings on the right. U.S. Forest Service photo.

To attain these objectives, the Forest Service might:

(1) Complete thorough multiple-use plans for all Ranger Districts as soon as possible, giving balanced consideration to all uses and services.

(2) Consult frequently with all interested elements of the people in making multiple-use plans.

(3) Conduct thorough public hearings, perhaps with staff specialists in public communications; provide opportunities for questioning the speakers--before decisions are made. Announcements of management decisions without prior public consultations lead to disharmony.

(4) Review with the interested public multiple-use plans and plans for activities that may impinge on other interests. Change the Multiple Use plans as needed to keep them up to date.

(5) Make multiple use impact studies of all proposed actions that may threaten environmental or other values.

(6) Accelerate related research. Two research needs are to be (a) Forest landscapes in relation to other activities, and (b) silvicultural practices for maintaining scenic forests.

(7) Seek staffing and finances for all activities provided for in multiple-use planning.

(8) Train and use staff specialists in all multiple uses of the forest lands.

(9) Educate the people. If the people are to contribute meaningfully to management decisions for the national forests, they need to be more than objectors.

CHAPTER II

CASE STUDY NO. 1

French Pete Creek Valley
Willamette National Forest
Eugene, Oregon

(1) Recitation of Facts

In 1937, the Chief of the Forest Service established the Three Sisters Primitive Area (some 191,100 acres) under authority of Regulation L-20. In 1938, some 56,000 acres were added, mostly west of Horse Creek including the French Pete Creek Valley. In 1939, Regulation L-20 was revoked and Regulations U-1 (36 C.F.R. 251.10) and U-2 (36 C.F.R. 251-21) were adopted to provide for the establishment and management of Wilderness and Wild Areas Wild Areas are 5,000 - 100,000 acres in size. Both areas are kept roadless with no commercial timber cutting and few other resource uses.

The Three Sisters Primitive Area was restudied by the Forest Service in 1955, as directed by law. A heated controversy developed between recreationists and the timber industry. After long study and public hearings, the Secretary of Agriculture on February 6, 1957, established the Three Sisters Wilderness and omitted some 53,000 acres (including French Pete Creek Valley) from the old Primitive Area because these lands were determined to have greater public value under full multiple-use management than under Wilderness management. In his 1957 decision the Secretary directed the Forest Service to designate special botanical and geological areas where appropriate, to develop camping facilities, to protect scenic values and to harvest timber in an orderly manner following multiple-use guidelines. No development or timber cutting will occur until the preparation of an adequate management plan. The Forest Service reported, "this decision was never accepted by the Sierra Club which regarded it as representing a major defeat. As a result, members of the Club protest or appeal each time any development of the area is undertaken."

A management plan was prepared in which four areas of special interest were set aside. The first Multiple-Use Plan was completed in 1959, and revised in 1960. It was incorporated into the Blue River Range District Plan in 1964. Special plans were prepared for the French Pete drainage in 1969.

In 1968, protests were directed at the Willamette National Forest's announced plans for limited timber harvest in the French Pete Creek drainage. A local Save-the-French-Pete-Creek Committee was organized by concerned citizens. The Forest Service held a series of meetings with groups and individuals and conducted field trips into the area to explain the management situation. No formal public hearings were held. The Forest Supervisor held that it was unnecessary since, "The public was informed about the proposal and public opinion was solicited." A public meeting at the University of Oregon sponsored by the Eugene Natural History Society was held on February 16, 1968, to formulate opposition views. That meeting was never accepted as a "public meeting" since Forest Service personnel did not participate.

Of particular significance is that recreation specialists at the Forest Service's Pacific Northwest Forest and Range Experiment Station apparently were not consulted in preparation of the French Pete Multiple Use Plan.

The request by the Citizens Committee to postpone thetimber sale was granted, and a team of Forest Service specialists restudied the area in the summer of 1968. This team made no contact with the Citizens Committee during their study of the area. It reported directly to the Forest Supervisor.

In early 1969, the Forest Supervisor appointed an Ad Hoc Committee of 23 persons broadly representative of the public interest in National Forest management. The Save-the-French-Pete-Creek Committee objected that they were not consulted on membership of the Ad Hoc Committee nor invited to appear before it. However, three members of theAd Hoc Committee were members of the Save-the-French-Pete-group, and 8 committee members were characterized as recreation or conservation-oriented. On March 13, 1969, the Ad Hoc Committee met for the first time at the Forest Supervisor's request. The Supervisor presented his tentative management plans to the Ad Hoc Committee and invited expression of opinion. Subsequently, he polled the Committee; 18 (of 23) Committee men expressed their support of the Forest Service's Multiple Use Plan proposal. On March 25, after careful review of the Committee meeting record, the Forest Supervisor approved a management plan meeting the specifications set forth in the 1957 decision.

On June 16, 1969, Mr. Brock Evans, Western Representative of the Federation of Outdoor Clubs, Seattle, appealed the Forest Supervisor's decision to the Regional Forester on behalf of eight conservation groups. At about the same time, Dr. Richard Noyes, one of the leaders of the Save-the-French-Pete-Creek Committee, asked (through the Regional Forester) for an audience with the Secretary of Agriculture. This meeting took place on July 7, 1969, in Washington, D. C., with Dr. Thomas K. Cowden, Assistant Secretary for Rural Development and Conservation.

On September 5, 1969, Dr. Cowden wrote to Dr. Noyes indicating the multiple-use plan for the French Pete Creek drainage was fully compatible, complementary and consistent with the established management direction. The multiple-use plan meets the overall public needs including provisions for recreation and protection of environmental values. In this way the area's welfare will be assured. The Regional Forester confirmed the Assistant Secretary's decision to Mr. Brock Evans.

On November 5, 1969, a new timber sale was advertised; new objections were raised. Mr. Brock Evans had written a letter on October 3, 1969, to the Board of Forest Appeals, Washington, D. C. Because of this appeal the conservationists thought Forest Service should not have proceeded with timber sale plans. Neither the Regional Forester nor the Forest Supervisor had been informed of this letter. On November 6, 1969, the Board of Appeals advised Mr. Evans that it had no power to grant a stay of the decision about French Pete and referred the matter to the Chief of the Forest Service where it now rests.

Senator Robert Packwood, Senator Mark Hatfield and Representative John Dellenback, all of Oregon, asked theForest Service to be extremely careful that all avenues of appeal had been exhausted before any final decision was taken. On November 17, the Secretary of Agriculture, Clifford M. Hardin announced withdrawal of sales for sixty days to allow opponents to make constructive suggestions and comments on the management of French Pete Creek drainage in writing, directly to the Chief of the Forest Service, by January 17, 1970. Presently there are no plans to hold local public meetings on the controversy.

On November 18, 1969, leaders of "Save-the-French-Pete" and "Nature's Conspiracy" held a rally in front of the Willamette National Forest Headquarters at Eugene. An estimated 500 to 2,000 men, mostly students, wished to speak to the Forest Supervisor. The Forest Supervisor refused to come outside but offered to receive a delegation of the group inside. This condition was unacceptable to the demonstrators. Both sides expressed later the hope to improve communications regarding the controversy. 7/

On December 19, 1969, Senator Packwood introduced a bill, S. 3262, in the Senate to establish the French Pete Creek Intermediate Recreation Area. "Intermediate Recreation Area" is a new term coined by the Save-the-French-Pete group. The purposes of this bill are: (1) no road construction or timber harvest activities of any kind; (2) no use of motor vehicles, motorized equipment, motorboats, or other form of mechanical transport; (3) no structures of installations, except as necessary to meet minimum requirements in connection with the purposes for which such area is administered (including measures required in emergencies involving the health and safety of persons within such areas, and the removal of dead trees which create a fire hazard). Trail construction, primitive walk-in campsites, trail bridges, sanitary facilities and other necessary facilities to further the purposes for which such area is administered may be provided. Sums to carry out these provisions are to be appropriated.

Under present conditions the position of Regional Forester and the Forest Supervisor was not to comment on the French Pete controversy beyond supplying facts that had been made available to the public and a copy of the Multiple Use plan on French Pete.

7/ A press statement in the Eugene Register-Guard of November 19, 1969. (This event was omitted from an official fact sheet on the French Pete controversy issued by the Supervisor's office).

(2) Environmental Impact

Anticipated environmental impacts would be those resulting from road building and logging. The primary controversial impact would be destruction of the wilderness character of the valley. Roads and timber harvest are not compatible with wilderness.

Air quality would be unaffected except during slash burning. Cutting practices and road building as planned should have minimal impacts on water quality. Cutting would be designed to fit the topography by landscape architects, but . . . "the experience of a virgin forest expanse (as far as the eye can see) . . ." would be lost. 8/ The same French Pete Committee report contends: elk would be driven out; the cutthroat trout fishery would be damaged; stream ecology would be upset; projected changes in the socioeconomic structure of the Oregon population will mean increased demand for dispersed recreation.

The Forest Service replies: special attention will be devoted to enhancing wildlife habitat; the Forest Service and the Oregon Game Commission jointly studied the fishery (The Game Commission contributed to preparation of the Multiple Use plan); the primary objective of managing the fish-producing streams will be to maintain water quality and improve fish habitat; following public hearing in 1957, the Secretary of Agriculture concluded that the area "has greater public value for multiple-use management than for classification and management as wilderness." This decision was reconfirmed in the Secretary's office in 1969.

Minimizing recreational impact upon the entire watershed requires careful planning and management. Timber harvesting and access road construction come in direct conflict with the scenic and recreational values. Management activities like construction of temporary roads, salvage of dead or diseased trees, fire protection, stream habitat and wildlife habitat improvement are necessary to enhance and protect the recreational and wildlife values of this area. Such activities are forbidden in wilderness areas by law.

From the social and economic viewpoint, recreational opportunities in a natural environment in close proximity to metropolitan centers are becoming increasingly rare. Such opportunities are vital and necessary to the welfare of an increasing population living in an urbanized society and, therefore, constitute a most important use of public lands.

The allowable cut of the Willamette National Forest will not be adversely affected by removing the French Pete acreage from the commercial timber area of the working circle. In the past, annual fluctuations in allowable cut volumes have varied more than the presently projected annual allowable cut of 7.7 MMBFM based on a 90-year rotation.

8/ French Pete Committee Report, 1968, p. 13.

(3) Problem Origins

The problem stems from conflicting views regarding management objectives for the French Pete drainage. Wilderness-oriented groups (those discussing low-density recreation opportunities) are unwilling to accept management decisions by the Forest Service and the Secretary of Agriculture. Forest Service plans call for a great deal of recreation development, consideration of aesthetics, water quality and wildlife and fish habitat. They have the approval of the State Game Commission. But development of this kind is not compatible with wilderness use.

Multiple Use - Sustained Yield Act of 1960 is mentioned frequently by the contenders to support both courses of action. The Act does not contribute to the controversy, however. It is flexible enough to permit either course of action. The controversy developed over conflicting philosophies for use of the area.

The controversy has been changed and nourished by the proponents of dispersed recreation feeling that they have been denied a meaningful role in the administrative decision-making process. The Forest Service contends that all interested and concerned segments of the public contributed to the Secretary's 1957 decision. The Forest Service apparently feels that a minority group is here refusing to accept a decision arrived at through democratic processes seeking the greatest benefits for all people. This feeling leads to real or imagined inconsiderate treatment for the "minority," thus feeding the controversy more.

(4) Alternatives

The Forest Service has apparently considered all significant environmental and ecological aspects of the situation. As one member of the Ad Hoc Committee wrote:

> I was convinced that the multiple use concept would do the greatest good for the most people. I was impressed with the time and thoroughness spent in developing this plan. I felt the Forest Service had made every effort to give the opponents a chance to have a fair hearing and had conscientiously tried to accommodate them. I was impressed at the number of local State agencies endorsing the plan. There is very little wildlife or fish in the area now. I was impressed that the Fish and Wildlife management people were in favor of the plan and had a hand in developing it. I felt that the opponents were few in number compared to the number of knowledgeable people favoring the plan. I felt their objections were more emotional than reasonable.
> I believe that from the information I have that the immediate implementation of the Multiple Use Plan developed by the many people involved is highly desirable.9/

9/ Letter, C. P. Tillman.

Special studies, public and other meetings, field trips and field investigations have all been undertaken since 1955. Multiple-use plans, designed to consider all uses and environmental protection have been prepared, modified and remodified in an effort to reach a compromise between the directive of the Secretary of Agriculture and the desires of the wilderness proponents. Plans give good consideration to all environmental factors except Wilderness and Wilderness aesthetics.

(5) Conclusions and Evaluations

This case does not appear to involve existing laws or legal procedures directly. It is a conflict of philosophies and management objectives. Intensification of the controversy in recent months is probably attributable to one of two things: (1) failure of the Forest Supervisor, Willamette National Forest, to win uniform acceptance of course of action he has been directed to follow, or (2) organized proponents of wilderness-type preservation refuse to accept any alternatives except their own and will fight to the bitter end; wilderness cannot be compromised.

The Forest Service might have minimized opposition if public meetings had been held periodically during the preparation of the multiple-use plan. This would give interested groups an opportunity to contribute suggestions during the formative stage of planning and give the Forest Supervisor an opportunity to discuss alternatives with them.

In view of the widespread opposition to the French Pete Multiple Use Plan, and the interest of lawmakers in the case, considerable doubt exists in the public mind about the wisdom of the Forest Service decision and the course of action it chose to follow.

The Save-the-French-Pete Group claims that decisions were irrevocably made before they had a chance to make their wishes known. Skillfully conducted public meetings can be helpful, but on the other hand, they may be useless against minds of individuals or groups that are irrevocably committed.

We can recommend no alternatives except that the Forest Service consult with the public more. We believe that full exposure of forest officers to the public's wants will lead to decisions truly reflective of the public interest. Many of the Save-the-French-Pete group want to go further and "participate" in Forest Service management decisions. The Forest Service by law cannot abrogate that authority or responsibility. It would not be good organizationally nor administratively for them to do so.

The Save-the French-Pete Committee and supporting groups have had the weapons of a democracy at their disposal in their never-say-die fight for something they believe in. The Packwood Bill is probably their ultimate weapon. This is the way it should be. Properly exercised, the democratic processes should lead to decisions that will most nearly accommodate the wants of the whole people. As the public becomes increasingly enlightened and aware of environmental values, they will assure, through democratic processes, that these values will get increasing consideration.

CASE STUDY NO. 2

Teton National Forest
Jackson, Wyoming

(1) Recitation of Facts

The Jackson Hole area ofWyoming began on a cattle economy. However, the area was surrounded by wilderness, much of it in the Teton National Forest. Yellowstone Park lay to the north. The magnificent Teton Range has since become Grand Teton National Park.

The unroaded mountains of the Teton National Forest contained some of the largest elk herds in the nation. They also supported a large moose population. Hunting these animals required pack animals and guides. As a result, outfitting and guiding hunters became an important business in the area. Sixty outfitters now use the Teton. They have 83 camps on the Forest.

The two national parks attract numerous visitors. The superlative scenery and wilderness nature of the country attract both residents and visitors who have wilderness, aesthetic and conservation orientations. Winter sports are now also important around Jackson. The economy of Jackson Hole is now highly dependent upon recreation and tourism; more than 3 million people visited in 1968.

Economically remote, the Teton National Forest was used primarily for recreation and livestock grazing until about 1957-58. At that time timber was becoming increasingly scarce nationally. Industry was moving to the more remote areas. An epidemic of Mountain pine beetles was rapidly killing the old, over-mature lodgepole pine. Removal of the beetle-susceptable trees is much more economical than trying to destroy the beetles by direct control methods.

The Forest Service made a large timber sale on the head of Fish Creek. (Fig. 1) The area was the home of a large elk herd. The timber cut was heavy. The blocks were large and angular. The strips that were left between blocks were narrow. Cleanup after cutting was poor. Reproduction was slow to start.

Opposition to the cutting was widespread and sometimes bitter. Strong opposition was expressed by outfitters, dude ranchers, wilderness advocates, Wyoming and National Wildlife Federations, Wyoming Game and Fish Commission and others. Senators Clifford P. Hansen and Gale McGee were brought into the play by their constituents. The following are some of the arguments

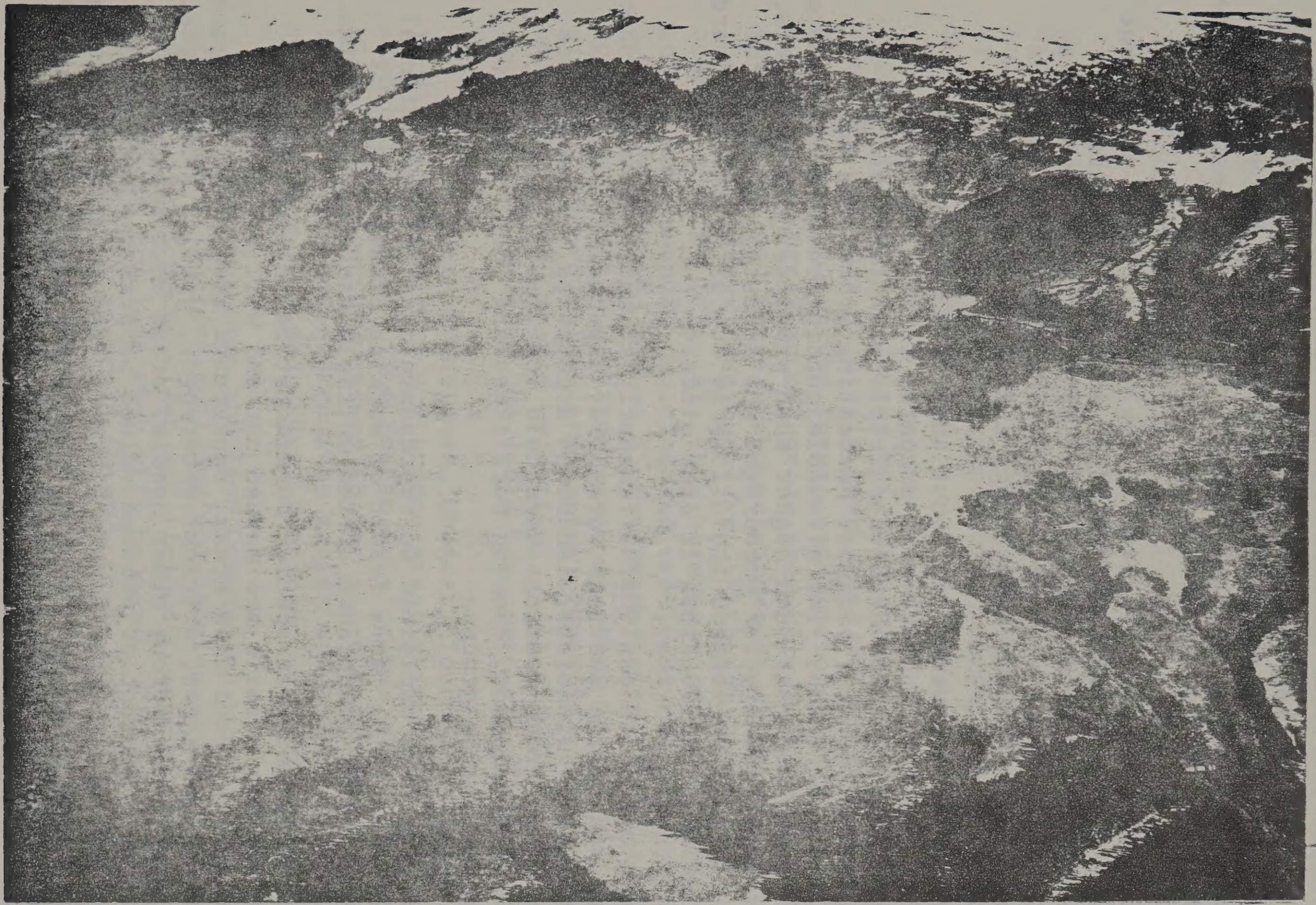

Fig. 1. The Fish Creek cuttings were unacceptable to the public on veral counts.

voiced: (1) the scenery was destroyed; (2) the Fish Creek elk herd was driven out by the activity, continued use of the road and limited cover that was left; (3) the cutting areas were not cleaned up, they were a mess; (4) unstable soils are likely to erode or slip; (5) the wilderness character of the area was destroyed; (6) the cutover areas are not reproducing.

Groups such as the Jackson Chamber of Commerce and livestock groups generally favored multiple-use management, including timber harvesting, as long as other values were protected. At the other extreme were individuals who wanted no roads, no trees cut.

Many Forest Service people recognized quickly that timber management practices would have to be modified in this area and that recreation-wildlife-scenic values would have to take priority over timber in setting management objectives. In this context, validity or lack of validity of the complaints against the Fish Creek cuttings lost significance.

Three significant moves were made about this time by the Forest Service: (1) "allowable cut" budgets were prepared for all national forests and made public; (2) comprehensive multiple-use plans were prepared for all ranger districts; (3) timber harvesting procedures were changed drastically on the Teton. The allowable cutting budgets for remote forests, like the Teton, were set much higher than previous cutting levels. Publicizing of allowable cut figures encouraged new industry and rates of cutting increased. The Teton reached its allowable cut of 30 million board feet annually in 1962 and has retained it ever since.

The public was consulted early and frequently in multiple-use planning. Both group meetings and public meetings were held. Specialists were consulted: geologists, soil scientists, landscape architects, entomologists, researchers and others. Group meetings were held for timber operators, Wyoming Fish and Game Commission, Wyoming Outfitters and local recreation, conservation and preservation groups.

The completed plan was explained to representatives of some national organizations on a field trip. As a result of working closely with the public there was widespread acceptance of the multiple-use management plan.

The multiple-use plan gives special consideration to environmental features. Areas of unstable soils are mapped out and will receive very little disturbance. Foreground view areas, background view areas, big game winter ranges, elk calving areas, critical watersheds, special game ranges, "Snake River Corridor" and numerous other special areas have separate management objectives to protect or enhance values of primary importance. In management unit I-5, Gros Ventre Ranger District, for example, "it has an unusually scenic and attractive back-country atmosphere and will be managed to protect and enhance that atmosphere." (Teton National Forest Multiple Use Plan).

The new cutting practices also helped. Landscape architects were consulted, including R. Burton Litton, University of California Forest and Range Experiment Station. These men are leaders in the new application of landscaping in forestry. Cuttings, designed to blend with natural openings and to harmonize with the topography, became difficult to distinguish from natural openings (Figs. 2, 3). Cutting units were limited in size to no more than 35 acres (20 acres in the high elevation "Crest Zone"). Not more than 1/3 of a drainage would be cut over at one time.

(2) Environmental Impacts

Impacts of the Fish Creek cuttings were substantial on the following: wilderness values; vegetative patterns and scenic resources; elk habitat, distribution and harvesting; habitat for destructive bark beetles. Roads and conventional clear-cut timber harvesting that remove a large proportion of the timber stands are completely incompatible with wilderness values. Such values were destroyed.

Clear-cutting causes definite changes in vegetative patterns. Furthermore, it degrades an area's aesthetics for most viewers. Most people find natural openings in the forest unobjectionable. They often fit the landscape. Borders are irregular and grade gradually from open land to forest. The forest-open land pattern commonly changes in harmony with the topography. That is not always true, however. Nature is not always a perfect landscape architect (Fig. 4). Furthermore, concepts of beauty differ according to the backgrounds, training and emotional make-up of individuals. The artist who painted Figure 5 put a vegetative pattern of square openings bounded by straight, narrow lines of trees in the left background of his picture. According to landscaping principles, this pattern would be totally unacceptable if created by cutting. (1) Had the artist found the pattern unattractive, however, he would have painted a different one.

All viewers questioned, however, found the beauty of the Fish Creek landscape viewed from a distance greatly impaired. The near-view scene was also badly damaged. The Forest Service was slow to clean up the logging slash. Abundant dead trees in the stand contributed to the debris. After the debris was bull-dozed into strips and burned, the black lines of charred, partly burned logs and debris remained. Reproduction of the forest was slow.

The Wyoming Game and Fish Commission reported that elk left the Fish Creek area. The road building and logging activity, continuing traffic on the road, logging slash and limited remaining timber cover are blamed. No one knows how long they will be gone. Elk are more a wilderness animal than deer. Thus any road impairs their habitat.

Some objectors claimed that if the elk moved onto another range that total numbers would be reduced. A range will hold only a limited number of animals. This is unlikely in Jackson Hole where the limiting factor is winter range. The number of animals that the winter range can accommodate is far less than the carrying capacity of summer range, which includes most of the timbered lands.

[illegible] with natural openings are difficult to detect in this scenically sensitive area (Teton No. 1).

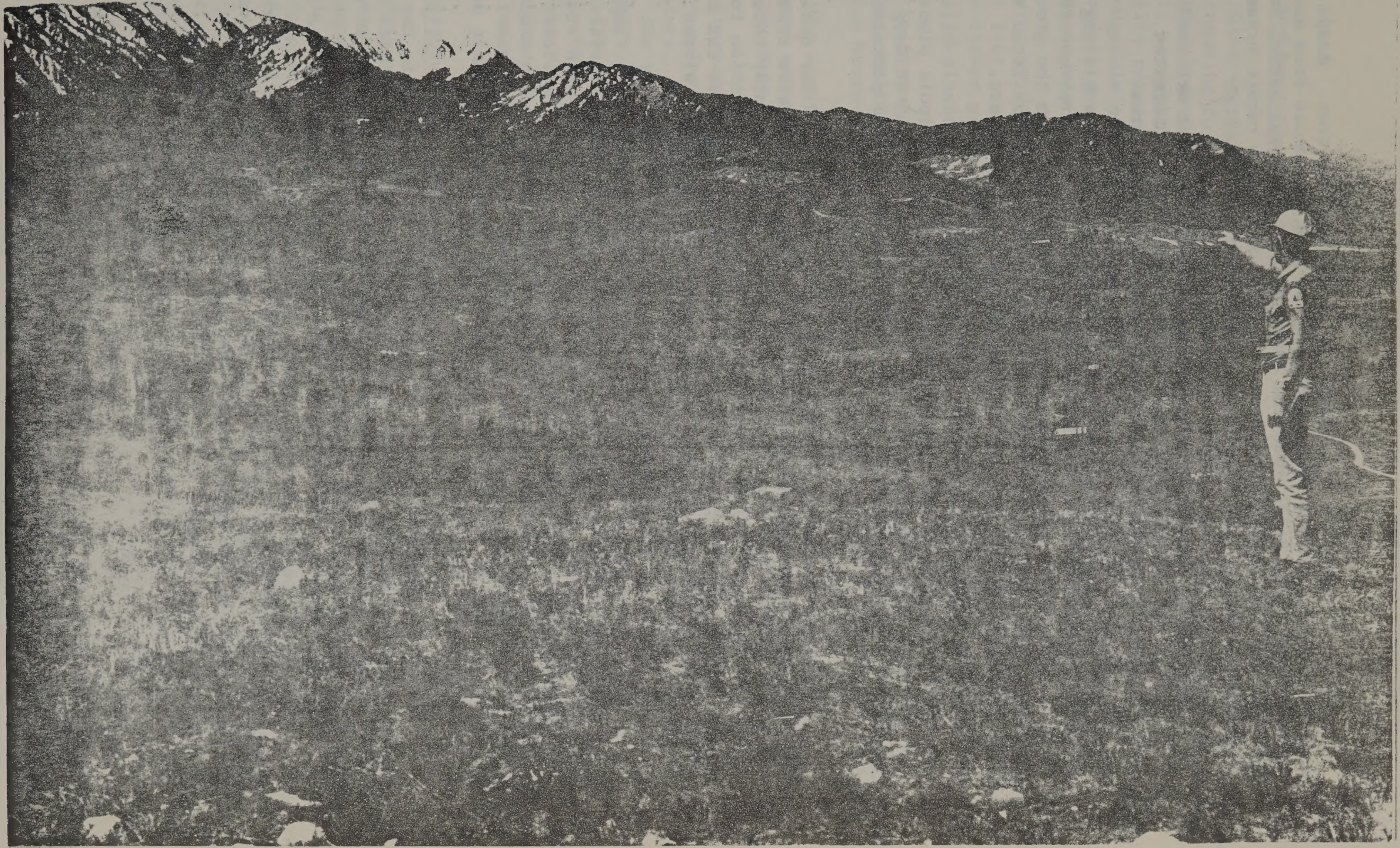

Fig. 3. Cutting units fitted to the topography are proving acceptable aesthetically (Teton No. 3).

Part of sound elk management is harvesting the crop. Roads help hunters harvest the big herds that migrate long distances from summer to winter range. But roads into the homes of smaller local herds, such as the one in Fish Creek, could force the herd into more remote areas and reduce harvest.

Elk have definite calving areas in the forest that are used year after year. It is important that these areas remain unmolested. No calving areas were reported in the Fish Creek cutting area.

One favorable change was in the habitat of the tree-killing bark beetles. Substantial breaks in the continuity of old, over-mature timber, coupled with direct control (spraying infected trees from the ground) reduced populations to endemic proportions. In the nearby Teton Wilderness Area where no control was undertaken, the epidemic persists.

Some wilderness enthusiasts contend they prefer a beetle-killed forest to a logged forest. When a dense forest of lodgepole pines falls over, however, it may produce a jackstraw effect 3 to 5 feet deep that can exclude all big game as well as hikers, saddle horses and packstock. It also represents a bad fire hazard.

Other environmental impacts were less significant. Air quality was not affected except during slash burning. Fears of excessive erosion, land slips and reduced water quality were expressed but apparently these effects did not materialize. Soil stability requires special attention in parts of the Teton. It is so young geologically that streams have cut down faster than ridges and slopes. This creates "super-steep" slopes that slide occasionally even when undisturbed.

Roads alone deteriorate the environment for many users. Impact on wilderness and elk herds has been discussed. Beyond that, outfitters and dude ranchers do not want them; roads reduce the need for pack stock and guides and open up wilderness hunting and riding areas. Cattlemen do not like them as they expose their cattle to modern rustlers with trucks. Many local people who can find their way into remote areas with 4-wheel drive vehicles on primitive roads and trails do not like to have their areas opened up to the masses.

The new timber harvesting practices that have evolved in the Teton still necessitate roads and the concomitant effects on wilderness values. Nevertheless, they minimize the detrimental impacts of cutting on vegetative patterns and scenic resources (Figs. 2 and 3). Except for the roads the new cutting may even improve wildlife habitat (See Case Study No. 3).

Slash cleanup must be prompt and complete. Slash can be burned only during the "off" season for tourists and recreationists. Soils, water quality, fish and wildlife receive special consideration.

(3) Problem Origins

Clear-cutting is a standard silvicultural method for harvesting forests and preparing for a new crop of trees. It is especially suitable for lodgepole pine because: (1) the pine is shade intolerant, it reproduces best in full sunlight and produces best in even-aged stands; (2) lodgepole pine typically retains numerous unopened cones which contain thousands of seeds; (3) lodgepole pine is frequently infected with parasitic dwarfmistletoes that reduce growth and sometimes kill the trees. Clear-cutting is the only known way to control it.

The epidemic of mountain pine beetles in lodgepole pines in the late 1950's lent urgency to foresters' desires to break up the patterns of overmature timber as one step in controlling the beetles and in avoiding economic waste.

Logging road development is typically financed from timber sales. The long, relatively expensive road into the headwaters of Fish Creek required a heavy harvest cut to finance.

The combination of beetles and heavy clear-cutting produced results that were especially damaging to wilderness and aesthetic values and to big game range.

Increased industrial capacity, stimulated by publication of Forest Service allowable cut figures, promised increased forest "devastation" for the future. This situation was especially unacceptable in the Jackson Hole area. The economy is heavily dependent upon tourists, recreationists, hunters and others attracted by the superb beauty, wilderness and big game of the area. The big-game outfitters and dude ranchers are especially dependent upon the unspoiled character of the area. Jackson Hole has also attracted residents who fled dirty cities in search of pure air and a pristine environment. None of these people were about to see spoiled the very things they worshiped nor the things on which their livelihood depended.

(4) Environmental Considerations

This case study illustrates an essentially explosive situation which has been kept under reasonable control through close consultation of the land managing agency with the publics it serves and through careful, detailed planning to preserve fundamental environmental values. The multiple-use planning paid special attention to scenic values, recreational values, soil stability, fish and wildlife habitat, water and air quality and wilderness values without sacrificing commercial uses of the Forest. Two points need emphasis here: (1) environmental needs received first consideration, commercial uses were secondary; (2) all interested segments of the public had opportunities to contribute to the planning, thus minimizing chances that any environmental factor would be overlooked.

Geologists and soils specialists were brought in to identify unstable land forms and soils that would need special consideration. Landscape architects trained forest personnel and helped identify special scenic foregrounds and backdrops that would need special management. The plan was coordinated throughout development with the National Park Service, National Elk Refuge, Wyoming Game and Fish Commission, Outfitters Association, Dude Ranchers Association and timber and livestock interests.

It needs to be emphasized that the plan is new. Performance under the plan looks promising. Recent timber cuttings are being accepted (Figs. 2 and 3). It will take continued skillful execution of the plan and continued public consultation to assure continued emphasis on the values that the people want protected and enhanced.

(5) Alternatives

We consider this a well-handled case. The course of action taken is the best alternative in our view. Comprehensive planning and free interchange of information and ideas with all interested segments of the public has produced what appears to be a good plan for managing all the forest resources. The plan is probably not perfect. Weaknesses may show up. Mistakes may be made in its execution. But if executed in a spirit of partnership with the forest users, weaknesses will be spotted and corrected early and mistakes should be minimized.

Not all segments of the public are completely satisfied. One of the authors attended two meetings in Wyoming at which Forest Service officers explained plans and programs to interested groups of people. Many points of dissension were raised. Some of the more ardent wilderness worshipers even suggested that the Forest Service should build no roads nor cut any timbers without first holding a public hearing. We cannot agree with that alternative. Administrative agencies must have authority and freedom to carry out plans that reflect concerns and recommendations of a broad cross-section of the public.

CASE STUDY NO. 3

Fraser Experimental Forest
Arapaho National Forest
Fraser, Colorado

(1) Recitation of Facts

A "jury" of 20 people (foresters, hydrologists, specialists in watershed management, engineers, soil scientists and forest administrators) met in 1949, and planned cutting experiments for Fool Creek, Fraser Experimental Forest, Colorado. The primary purposes of the experiments were to test methods of cutting and regeneration of lodgepole pine and Engelmann spruce and to determine influence of cutting on water yield and water quality. Thirty-nine percent of the 714-acre watershed was clear-cut in 1954-56. One hundred eighty-three strips (one to six chains wide) were cut to provide one of the most complete pattern cuttings ever made (Fig. 1).

This case is valuable because many environmental impacts were measured. Streamflow and precipitation records were collected for 13 years before cutting and continued after cutting on both Fool Creek and a "check" watershed, East St. Louis Creek. Responses of the forest and of big game animals were also studied.

(2) Environmental Impacts

The cutting had significant impacts on water yield, water quality, wildlife habitat, vegetative patterns and scenic and recreational resources.

Water yield from the watershed was increased by 25 percent (4). This increase has held up well for the 13 years since cutting. This increased flow comes primarily during the spring run-off from melting snow. Late summer, and fall run-off differ little from run-off before cutting. Reasons are explained as follows: (1) snow is redistributed, more is blown into the cut strips than into the timbered strips; (2) vegetation in the cut strips uses less water than in the timbered strips, so soil moisture deficits are less, and less water is needed to recharge the soil; (3) snow in openings melts faster and is exposed to evaporation losses for a shorter period.

Sediments in the water increased significantly in the statistical sense, but insignificantly in the practical sense. Sediment yields before cutting averaged 11-21 pounds per acre. During construction of the 12.1 miles of road and logging, sediment yield averaged about 200 pounds per acre. It decreased rapidly following cessation of activity and now averages 43 pounds per acre. Water temperatures were not measured, but little change was likely as cover was left over the stream (Fig. 1).

Cutting openings in timber stands typically improves habitat for game animals (deer, elk, rabbits) and many birds (doves, grouse). (O. C. Wallmo, personal interview) One to three years after logging, deer used Fool Creek less than East St. Louis Creek (uncut) (5). This distribution of deer is now attributed to the dense logging slash left on the area and disturbance during road building and logging. Ten years later, however, use of Fool Creek by deer was about twice as great as use of East St. Louis Creek; elk use was 17 times greater according to the data, but data may be weak (6).

The vegetative pattern was strikingly altered (Fig. 1), but the pattern is less apparent from the ground within the area (Fig. 2) than from a distant view. Cuttings of this type (in evenly spaced strips having straight sides and square corners) have the most detrimental impact on aesthetics. There has been little public criticism of these cuttings, however. This is attributed to: (1) the cuttings are not in full view from major roads or highways; (2) local people understand the reasons for the cuttings.

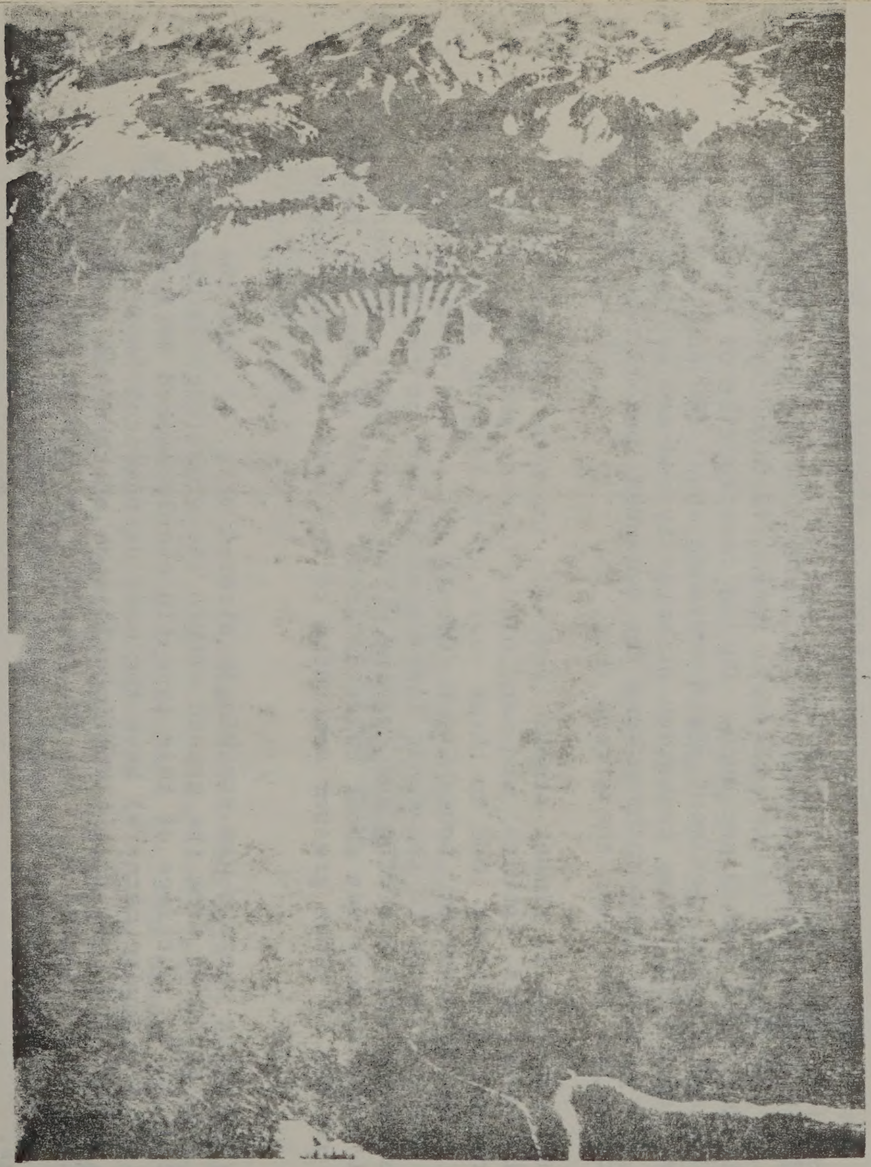

Fig. 1. Pattern cuttings.

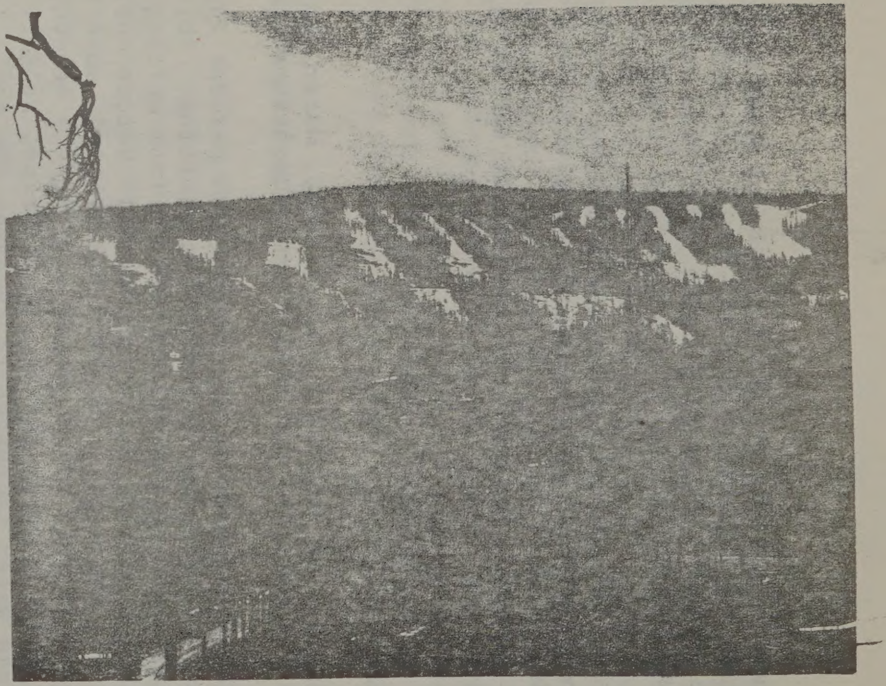

Fig. 2. Pattern cuttings from ground.

Public use of the area has actually increased so much that it threatens the research. Local people frequently drive up and even picnic in the area because the cuttings make it possible to "see out." The near view may not be attractive, but there are many attractive distant vistas.

Cuttings of this type let wind into the stand which leads to wind throw of timber. Windfall losses which occurred primarily the first year or two after cutting were not excessive (2).

The spruce-fir stands contained numerous small trees under the old-growth. Most of these survived logging and formed the nucleus of the next stand (1). New reproduction has been slow. This is attributed to poor seed years (3).

(3) Problem Origins

This case study is not considered to represent a problem. Rather, it is a contribution to understanding some of the environmental impacts of clear-cutting in strips or patches.

(4) Environmental Considerations

As explained, these cuttings were designed to measure impacts on water yield, water quality and forest responses. The studies were planned by a team of specialists (Appendix A, Case Study No. 3, Exhibit 1) and scientifically designed under authority of the McSweeney-McNary Act of May 22, 1928 (45 Stat. 699, as Amended and Supplemented (16 U.S.C. 58a-581i-1)) (Appendix A, Case Study No. 3, Exhibit 2).

(5) Conclusions and Evaluations

Legal authorization was adequate to consider all significant environmental and ecological impacts. No alternatives need be considered.

CASE STUDY NO. 4

Sanitation Tree Removal in Recreational Areas Southern California

(1) Recitation of Facts

In 1953-54, an initial sanitation treatment against bark beetle was conducted in the Barton Flats Recreational Area on 55,457 acres of the San Bernardino National Forest. The selective removal of high risk trees reduced the mortality by 60% (1).

At Big Pines of the Angeles National Forest the oldest sanitation treatment began in 1955. These cuttings effectively suppressed insect damage through at least 1962 (1).

A serious epidemic of bark beetle outbreak began in 1958, at May Valley and in 1959, at Baldy Mountain extending over 2,460 acres. In 1962, no epidemic losses occurred amounting only to about 10% of estimated original mortality (1).

A serious bark beetle outbreak was treated by a sanitation treatment on Alamo Mount in the Los Padre National Forest in 1958-1960 (1).

(2) Environmental Impact

Lack of bark beetle control results in catastrophic losses among pine trees. Direct control will suppress the losses but will not assure that losses can be reduced to tolerable limits (1).

Sanitation treatment improved the safety and aesthetic aspects of recreational areas; there was public acceptance of these harvesting practices in campgrounds (3).

(3) Problem Origins

Bark beetle epidemic outbreaks occur periodically in natural forests in which no cutting has been made since earliest pioneer days. These forests are now heavily used for recreation.

(4) Alternatives

Direct control by tree removal and application of insecticides has not assured against future losses of pine trees. Epidemic outbreaks occur naturally in these stands. Without any direct removal of checking bark beetle outbreaks, catastrophic losses have occurred (1).

No alternative has been found other than preventive treatment (sanitation cut) by removing high risk trees.

Another alternative, "let nature take its course," is often recommended by preservationist groups. This is unacceptable from the standpoints of public safety and aesthetics.

(5) Conclusions and Evaluations

Light selective cutting that removed about one tree out of every ten in high-use recreation areas proved to be acceptable to the public.

CASE STUDY NO. 5

West Side, Wind River Range
Bridger National Forest
Pinedale, Wyoming

(1) Recitation of Facts

The Wind River Mountains of Wyoming constitute one of the nation's most scenic areas. The west side of the mountains is in the Bridger National Forest and forms the eastern rim of the bowl of mountains framing the Upper Green River. Most of the National Forest is in the Bridger Wilderness Area, a spectacular mosaic of forests, mountain peaks, lakes and glaciers. National Forest lands outside the Wilderness form only a thin band (rarely more than four to six miles wide) between the Wilderness and the private lands below (Fig. 1).

Ranchers along the base of the mountains have turned increasingly to dude ranching and outfitting hunters for their livelihood. The mountains, which adjoin the rim of Jackson Hole to the West, harbor large herds of elk and abundant moose. The Green River Valley has large herds of antelope. Fishing in theUpper Green River, its tributaries and the numerous lakes both inside and outside the Wilderness is among the nation's best.

The economy of the area and its only town of consequence, Pinedale, was historically based on ranching. While ranching continues, recreation, hunting and fishing are increasingly important. The economy is therefore becoming increasingly geared to the superlative scenery and pristine environment.

Like the Teton National Forest, the Bridger was visited by an epidemic of mountain pine beetles starting about 1956. In an effort to stop the beetles and to salvage some of the doomed trees, several timber sales were made on the headwaters of Moose, Gypsum and Jim Creeks. These first cuttings were in large units and cleanup was poor. No effort was made to minimize the detrimental impact on aesthetics. Dude rancher L. W. "Bill" Isaacs had long used this as a place to take clients. The cutting embittered Mr. Isaacs and set an example for all to see of how poorly planned harvest cutting, made without specific consideration of environment, can damage aesthetics and associated values.

Populations of pine beetles expanded again starting in 1965. By 1967, about 100,000 acres were considered vulnerable; these included about 60,000 acres of timber, 12,000 acres of which were mature, lodgepole pine, sawtimber. After careful study it was decided to remove about half the mature sawtimber (50 to 60 million board feet) by clearcutting 6,000 acres in small patches.

Appreciating the wide public interest in the area, the Forest Service prepared a brochure explaining the situation, the decision and the reasons for the decision. The brochure was sent out first in December, 1967, to key groups including the Wyoming Congressional Delegation, Wyoming Natural Resources Board, Wyoming Governor, Wyoming Game and Fish Commission and members of the Advisory Board to the Bridger National Forest. The Advisory Board included Mr. Isaacs. Finally the brochure was made public at a meeting in Pinedale, Wyoming, on January 23, 1968.

Responses differed. Examples of those in favor of the action included Senator Clifford P. Hansen, John A. Reed (livestock), Bill Hallock (Izaak Walton League), Roy Peck (Executive Director, Wyoming Natural Resources Board), Thomas L. Kimball (Executive Director, National Wildlife Federation), and the Green River Valley Cattleman's Association. Those against included Daniel A. Poole (Secretary, Wildlife Management Institute) and Hank Snow (President, Pinedale Outfitters).

Initially, acceptance was much wider than opposition. However, the opposition organized, and the controversy grew increasingly bitter. Court injunctions were considered. The Wyoming Wildlife Federation asked for time to study wildlife implications. The Forest Service delayed action and ran hydrologic, soils and fishery surveys to determine potential damage to those resources and how to minimize it. The Forest Service then organized a field trip in June, 1968, to show conditions on the ground and to explain plans. A wide representation of interests was invited. Reponses continued to differ, even among outdoor groups (Appendix A, Case Study No. 5, Exhibit 1). No consensus was reached. After studying results of all new surveys and suggestions, the Forest Supervisor decided to proceed with four sales. The decision was explained in a long letter sent to 108 people representing all interests.

Leaders of the opposition met in Washington, D. C., with their congressional delegation and with leaders of "several national conservation organizations." The group decided to ask the Secretary of Agriculture to appoint a special "Blue Ribbon Committee" to study the Bridger National Forest. The request was made to the Secretary by Senator Gale McGee. McGee's action was both lauded and criticized. The problem had grown into a national issue.

Secretary Hardin declined Senator McGee's request. The Forest Service arranged a meeting in late June, 1969, for leaders of the national conservation organizations that were parties to the request; William E. Towell, Executive Vice-President, American Forestry Association; Brock Evans, Sierra Club; Thomas L. Kimball, Executive Director, National Wildlife Federation and Robert L. Herbst, Executive Director, Izaak Walton League.

The representatives of the four organizations were quite consistent in their recommendations (Appendix A, Case Study No. 5, Exhibit 2) which were summarized by Regional Forester Iverson as follows:

> All members of the group have recognized an urgent need for some form of additional long-range management planning, to assure proper overall objectives for the Bridger National Forest, and particularly that portion east of

> Pinedale which we refer to as the west slope of the Wind River Range. There is also general agreement that further and more intensive recreation planning for the Wind River slope is needed, and to better reflect long-range and short-range management objectives for the area and to identify more clearly the coordination needed to properly blend recreation, wildlife, and aesthetic values with the others, that the planning--and particularly the recreation planning for the area--should be well developed, reviewed, and commented on by interested out-Service people, and approved after careful consideration of such such comments, before a further timber-harvesting program is initiated there.
>
> Most of the group has recognized the desirability of doing some carefully planned and managed timber harvesting, if further overall consideration supports a real continuing need for this. At the same time, all have pointed out the unsatisfactory condition of some of the past timber-harvesting areas. For these reasons, the group has further recommended that considerable care be taken in the selection of any future timber production areas and in the manner of harvesting, cleanup and regeneration thereon, to assure that the future on-the-ground results in timber management are fully acceptable from the standpoint of the protection of watershed, aesthetic, recreation, wildlife, wilderness, and other values.
>
> Probably the principal concern expressed by the entire group related to our failure to effectively present the Forest Service program for the area. All have pointed out that we need to develop, with counsel from the people of Wyoming and elsewhere with whom we work, long-range objectives for the area, based on some form of comprehensive land use planning, which adequately reflect Forest Service concern and meet overall public needs regarding the principal values involved. This has been recognized in previous correspondence and discussed with you.

A Forest Service recreation planning team completed a plan for the west side of the Wind River Range. It was to be distributed for comments early in 1970.

In the meantime, the battle continued: Governor Hathaway criticized the Forest Service for not cutting the beetle-endangered timber; Senator McGee criticized cutting practices.

In this controversy the Forest Service has argued that up to 6,000 acres of mature lodgepole pine sawtimber that is threatened by mountain pine beetles should be harvested from the west side of the Wind River to (1) help control the beetles; (2) avoid economic waste and (3) avoid fire hazard and obstruction to travel by people and game animals that will result if the forest is permitted to die and fall down. Foresters point out that through today's procedures for multiple-use planning, other values such as soil, water quality, wildlife habitat and scenic resources can be given priority consideration.

The opponents contend: (1) logging permanently destroys natural beauty; (2) wild game is forced away during periods of road building and logging; (3) soils are exposed to erosion; (4) streams are damaged and silted; (5) roads, once built, remain and may encourage over-use of the area by recreationists; (6) domestic livestock are forced out during logging; (7) Forest Service is unable to police present access routes; (8) economic gains from the proposed timber sale are negligible; (9) Foresters cannot regenerate cutovers.

(2) Environmental Impacts

The impacts of clearcutting on environment were discussed thoroughly in Case No. 2, Teton National Forest. As impacts on the Bridger are similar, they will not be repeated here. Cuttings on Moose, Gypsum and Jim Creeks, Bridger National Forest, had all the detrimental impacts of the cuttings on Fish Creek, Teton National Forest. By the same token, cuttings that give priority consideration to environmental values could prove to be as acceptable on the Bridger as on the Teton.

The Bridger case differs in that area of controversy is only a narrow strip of land adjoining the Bridger Wilderness and no course of action acceptable to all parties has yet been reached.

(3) Problem Origins

The problem is rooted in opposing views about the sort of activities that should be permitted in the narrow strip of National Forest land that rims the west side of the Bridger Wilderness.

The Forest Service, supported generally by business interests, livestock associations, the timber industry and many public officials, wants to harvest timber by clearcutting to help control the bark beetle epidemic and to avoid economic loss. Opposition, apparently starting with the Pinedale Outfitters Association, Wyoming Wildlife Federation and a few other local people, grew as aid was enlisted from national outdoor organizations.

We feel the Forest Service position was weak. The west side of the Wind River Range is an area of superlative beauty and outstanding recreation potential. Few activities in the forest can damage natural beauty and recreation potentials as seriously as timber harvesting unless done with extreme care. Therefore, no cutting should be done until a complete recreation plan is drawn up and coordinated with a complete multiple-use plan for the area. Unfortunately, the cuttings made on Moose, Gypsum and Jim Creeks in 1956-60, were planned and carried out in an emergency atmosphere. "Hurry-up" operations rarely result in sound environmental planning.

The plans made public in December, 1967, were again prepared under the urgency of an insect epidemic. Neither a complete recreation plan nor complete multiple-use plan was available. So justifiably or unjustifiably, the Forest Service seemed to be caught in a position of "putting out brush fires" when it should have been planning strategy.

On the other hand, the Pinedale Outfitters seem to consider themselves uniquely qualified to judge the public's interest in its forests. When their president wrote, "We do not feel the public needs any more access roads to the Bridger National Forest . . .," he was saying in effect, "We know what's good for the public, and it's not more roads into Bridger." That is hardly an attitude that can lead to fair compromise. On the other hand, the federal laws governing the National Forests are flexible enough to permit any of the proposed courses of action (Appendix B).

Established practices and customs also contributed to the problem. The Forest Service has traditionally been a supplier of timber. Foresters are trained to manage forests for timber production. Recreation planning and management, and even multiple use practice are all relatively new. The demand for recreation has blossomed rapidly. The Agency has probably failed to keep up with the rate of change in the public's demands.

(4) Environmental Considerations

The first cuttings in the area, made on Moose, Gypsum and Jim Creeks were concerned primarily with beetle control and salvaging timber values. The only environmental and ecological considerations emphasized were removing host trees for beetles under a harvesting system that was ecologically sound for reproducing and growing lodgepole pine.

Later planning gave consideration to all environmental factors that were considered important: scenic values, wildlife, water, soils and wilderness, in addition to the ecology of the beetles and forest.

In the two-plus years of controversy several studies, investigations and meetings were held:

December, 1967. Brochure explaining the threat of a beetle epidemic and proposed actions sent to key people.

January, 1968. Public meeting held at Pinedale, Wyoming to explain the situation and proposed actions.

June, 1968. Field trip to acquaint interested people with the situation on the ground.

Summer, 1968. Wyoming Wildlife Federation studied wildlife implications of proposed cutting.

Summer, 1968. Forest Service specialists studied soils, watersheds and fisheries in proposed cutting areas and the potential impact that cutting might have on them.

October, 1968. Gordon Robinson, Forestry Consultant for the Sierra Club, studied and reported on the whole problem.

February, 1969. Situation reviewed again, and decisions reported to 108 citizens in letter from forest supervisor.

June, 1969. Special field review by leaders of four national conservation organizations.

December, 1969. Recreation plan for the west side of the Wind River Range completed.

The recreation plan is being reviewed by interested parties at the time of this writing.

(5) Alternatives

The Forest Service presented a model of single use development, carried out in an atmosphere of emergency, at Moose, Gypsum and Jim Creeks in 1956-60. With that model before the public, planning for new cuttings in 1967 virtually had to be a perfect model of multiple-use planning to avoid controversy. Apparently the new plans did not satisfy that role.

On the other hand, the Pinedale Outfitters seem to claim a certain prerogative in recommending best use of the people's land. They may not be willing to settle for less than no roads and no cuttings.

There are no legal obstacles or policy obstacles in the way of choosing among alternatives. The only obstacle appears to be in arriving at the best decision for the area. Any decision made will meet with resistance from one segment of the public or another. The question remains, which use will be best for the most people in the longest run.

We believe that here the public is making known to a public land managing agency, the Forest Service, its recommendations for managing those public lands. The Forest Service is responding. We recommend continuing and improving the same sort of communication to the point where controversy can be minimized.

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List of Key Individuals Interviewed

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George Fry, Timber Management Staff, Teton National Forest.
Ernest Hirsch, Recreation and Lands, Teton National Forest.
Jackson Hole Forum. This was a meeting at Jackson, Wyoming at which the Supervisor and three staff men from the Targhee National Forest explained their management plans to the Jackson Hole Forum which is an organization of recreation-conservation oriented citizens. About 30-35 people attended and expressed views on National Forest management.
Robert Safran, Supervisor, Teton National Forest.

Case Study No. 3

1. Alexander, Robert R., 1956, Damage to advanced reproduction in clear-cutting spruce-fir. U.S.F.S. Rocky Mountain Forest and Range Experiment Station. Research Note No. 27, 3 pp. illus. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

2. Alexander, Robert R., 1967, Windfall after clear-cutting in Fool Creek, Fraser Experimental Forest, Colorado. U.S. Forest Service Research Note RM-92. 11 pp. illus. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

3. Alexander, Robert R., 1968, Natural reproduction of spruce-fir after clear-cutting in strips, Fraser Experimental Forest. U.S. Forest Service Note RM-101. 4 pp. illus. Rocky Mountain Forest and Range Exp. Station, Ft. Collins, Colorado.

4. Hoover, Marvin and Charles F. Leaf. 1966, Process and significance of interception in Colorado subalpine forest. Proc. National Science Foundation Advanced Science Seminar. Penn. State Univ. 1965.

5. Porter, K. A., 1959, Effects of subalpine timber cutting on wildlife in Colorado. Unpublished masters thesis on file at Colorado State Univ., Ft. Collins.

6. Wallmo, O. C., 1969, Response of deer to alternate-strip clear-cutting of lodgepole pine and spruce-fir timber in Colorado. U.S. Forest Service Research Note RM-141, 4 pp. illus. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

List of Key Individuals Interviewed

Robert R. Alexander, project leader, Timber Management Research, Engelmann Spruce-subalpine Fir and Lodgepole Pine Project.
Marvin D. Hoover, Project Leader, watershed management research.
Charles F. Leaf, Hydraulic Engineer, watershed management research.
O. C. Wallmo, Project Leader, Wildlife Habitat Research.

All the above are with the Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

Case Study No. 4

1. Hall, R. C. & J. R. Pierce, Sanitation treatment for insect control. U.S.D.A. Forest Service, California, 1965, 21 pp.

2. Hall, R. C., Sanitation Salvage Controls Bark Beetles in Southern California Recreation Area. Journ. Forestry 56 (1) 1958, (9-11).

3. Rosecrans, W. S., Logging in recreational forests, American Forests, May, 1957, reprint, 5 pp.

APPENDIX A

CASE STUDY EXHIBITS

CASE STUDY NO. 3

Exhibit 1:

Although this memorandum summarizes the recommendations made by the Fool Creek Jury, it also summarizes the action to be taken by the Station to further these recommendations. Thus, this report is considered a Supplement to the Project Working Plan entitled "The Effect of Timber Cutting on Water Yield in the Central Rocky Mountains" dated April 1, 1943.

History and Purpose

For the past seven years stream flow and precipitation records have been obtained for two drainages; namely, Fool Creek of 710 acres, and East St. Louis Creek of 2,430 acres. The objective of the study is to determine the influence of timber cutting on water yields from a small watershed in the lodgepole pine-Engelmann spruce-alpine fir type of the Central Rocky Mountains.

Records in 1940 for Fool Creek, while for East St. Louis Creek they began in 1943. With the exception of the year 1940-41 when the Fool Creek gage was operated yearlong, the period of stream-flow records extend from approximately April 20 to September 25 of each year. A snow survey of each watershed along established snow courses is made each spring before snow-melt starts to determine the winter snow accumulation. Spring snowfall is measured by gages which also serve to record summer rainfall. A series of four ground-water wells at the Fool Creek gage only are used to indicate ground-water fluctuations. Recently a hygrothermograph was installed upstream from the Fool Creek gage to compare temperature and humidity measurements with the main climatic station near headquarters. For the watersheds, the average annual precipitation amounts to 26.5 inches.

The study of the influence of timber harvesting on water yields from a small watershed is an outgrowth of the lodgepole pine plot studies reported in Technical Bulletin No. 968 entitled "Effect of Timber Cutting on Water Available for Stream Flow from a Lodgepole Pine Forest." These studies pointed to the increased precipitation available for stream flow under different reserve timber stands. An increase of 31 percent in the water available for stream flow was found comparing uncut plots with the heavily cut-over plots. Similar results have been obtained from plot studies in Engelmann spruce-alpine fir (26 to 30 percent) and young lodgepole pine types (15 to 20 percent). These latter studies have also demonstrated that increased water available for stream flow is related more to the amount of tree canopy removed than to the type of harvesting employed. Snow melts more rapidly on the cut-over plots. Though the snow accumulation is greater on these areas, it disappears from all plots at about the same time. A limited amount of physical-factor data is available from which to analyze snow-melt. Indications are that the rate of snow-melt is related to air temperature, humidity, and wind movement. Snow evaporation studies indicate that from two to three inches may be lost during the winter and spring months.

Exhibit 2:

4021.2 - Research Acts

McSweeney-McNary Forest Research Act of May 22, 1928 (45 Stat.699), as Amended and Supplemented (16 U. S. C. 581a-581i, 581i-1).

This was the first law dealing entirely with forest research. FSM 1021 quotes this act in full. In the introductory section, the Secretary of Agriculture was directed to conduct experiments to determine, demonstrate, and make known the best methods for:

a. Reforestation and growing, managing, and utilizing timber forage, and other forest products.

b. Maintaining favorable conditions of waterflow and the prevention of erosion on forest and related rangelands.

c. Protecting timber and other forest growth from fire, insects, disease, or other harmful agencies.

d. Obtaining the fullest and most effective use of forest lands.

The act further authorized investigations to determine and make known the economic considerations which should underlie the establishment of sound policies for the management of forest land and the utilization of forest products.

The law provided for cooperation with individuals or agencies and for receiving money contributions from cooperators. It authorized specific appropriations for ten years (fiscal years 1929 - 1938, inclusive), and "such annual appropriations as may thereafter be necessary." The McSweeney-McNary Act authorized the Secretary to maintain in his discretion eleven specified regional forest experimental stations and to establish and maintain six additional stations. Individual sections of the act provide for research in silviculture and other forest management, forest pathology, entomology, wildlife, fire and fire weather, range management, and forest products at the Forest Products Laboratory or elsewhere; and for the forest survey and forest economics investigations.

CASE STUDY NO. 5

Exhibit 1:

CRISIS IN THE BRIDGER-1968

Gordon Robinson
Forestry Consultant
October 8, 1968

Owing to a build-up of mountain pine beetles, the Bridger National Forest in Wyoming, proposes to sell about half of the merchantable timber in the entire Wind River range west of Jim Bridger Wilderness over a three year period. Announcement of the proposal raised a storm of controversy, whereupon Supervisor William O. Deshler arranged a field trip involving about sixty people, June 22 and June 23, 1968, to help resolve the conflict. At the conclusion of the trip, the Forest Service agreed to postpone their final decision until they could evaluate responses from all interested parties. While I did not participate in the trip, I did visit Mr. Deshler and the Intermountain Region's Headquarters in Ogden while in the vicinity on other business late this August. Mr. Deshler mentioned that studies are now underway concerning economics, soils and other factors in preparation for a decision to be made in early 1969 on whether to go ahead with their plan to accelerate logging.

The Bridger National Forest contains 12,000 acres of commercial timberland with marketable timber on the west slope of the Wind River Range. This contains 139 million board feet of lodgepole pine. The accelerated plan would be to sell about half of this, or 60 million board feet over a period of three years. This is from ten to fifteen times the sustained yield capacity of the district and probably exceeds the sustained yield capacity of the whole Bridger National Forest. See table below:

TIMBER RESOURCES OF BRIDGER NATIONAL FOREST

	Millions of Board Feet	
	Total Volume	Sustained yield capacity
Bridger and Green River Districts	435	4 - 6
Total Bridger National Forest	1,160	12 - 17

The entire State of Wyoming contains only 17,173 million board feet of timber with an annual cut of 124 million board feet.

Only about half of the forest area of Wyoming is classed as commercial. This is land capable of producing useable timber and not reserved from industrial use in Parks, Wilderness and the like. The sustained yield capacity of the National Forest has been overestimated because the commercial classification includes considerable submarginal land as well as many areas on steep slopes and unstable soils that cannot be logged without seriously endangering watershed. The Intermountain Experiment Station is now studying criteria for classification of forest land to eliminate uneconomic sites, unstable soils, scattered tracts and areas identified for other use. We can, therefore, expect timber production to become even less important in Wyoming than it is now.

In Resource Bulletin INT-2, Ogden, 1963, the U. S. Forest Service indicates that no state offers a bigger package of attractions of forest recreation than Wyoming. In addition to some of the most magnificent scenery in the country, opportunities for camping, trailriding, hiking, boating, hunting and fishing have all contributed to recreation's surging development in recent years. Wyoming's forests are rapidly becoming more accesible for recreation. Increased use of Wilderness areas was nearly five hundred per cent in 1962 over 1946, surpassed only slightly by increased use for winter sports areas, campgrounds, hunting and fishing. The same publication emphasized that water is the most important product of Wyoming's forests, water being the key to the present and future development of the state. This has been recognized since early settlement.

There have been only seven timber sales on the Bridger National Forest since January, 1965. Stumpage prices are typically about $2.00 per M ft. B.M. The highest price paid was $5.40 and surprisingly, the most recent sale went for only $.50.

There are only three sawmills within reach of the proposed timber sale. Their combined capacity is about 7.5 million board feet per year, operating on one shift.

There has been an epidemic of mountain pine beetles in Southern Idaho and western Wyoming for a number of years. The epidemic apparently reached its peak in 1965. The Forest Service reported that year that "the mountain pine beetle continues its destructive march through the lodgepole pine forests of the Region. Over 2½ million trees are infested in severe outbreaks in the Grand Teton National Park and in the Teton and Targhee National Forests. Control by logging and other means has been undertaken to reduce the impact of the huge infestation in the Teton area on timber, recreational and scenic values. Biological control measures have had little impact on the population and cannot be expected to exert an immediate controlling influence; consequently, even greater beetle activity is forecast for most of the noncontrol areas in 1966."

The next year, however, they reported that "in many areas of the Targhee infestation, in addition to host depletion, factors like advanced broods and their susceptibility to adverse winter temperatures, competition with ips beetles, relatively low brood densities, high pitchout ratios, and persistent control work may finally indicate a reversal of the seemingly endless upward trend."

More encouragingly, in 1967, they reported that "the catastrophic situation which has long persisted in the Jackson Hole country, but exhibited weakening symptoms in 1966, declined even further in 1967. The most significant reduction was in the Teton Wilderness where, just two years ago, upwards of one million trees were attacked and killed .....Treatment of large tree groups is being continued, but with the present low infestation intensity and other favorable biological signs, it is possible that large-scale control efforts on the Teton Forest will be terminated in 1968."

With respect to the Bridger National Forest, they report that last year two altogether different situations existed. In the Wyoming division, infestations began to recede. Woodpeckering, competition from ips beetles and other natural factors materially reduced the number of new attacks. On the other hand, tree killing increased within existing infestations and new ones developed along the west side of the Wind River Range.

We have no present information on 1968 conditions. However, this summer has been unusual in the Intermountain area, there being a great deal of rain and snow during the month of August. This is likely to have an important effect upon the insect epidemic in addition to natural control factors which have so obviously already set in throughout the Intermountain area. When bark becomes damp and soggy with moisture, bark beetle larva are not able to develop successfully and are usually smothered by molds and fungi which develop best under such circumstances.

The Forest Service is considering the alternatives of attempting to control the beetles through accelerated logging in the Wind River range, or of letting nature run its course while maintaining timber sales at their normal rate.

The advantages of control measures are not very impressive:

*There would be utilization of some timber of marginal value, which would very likely otherwise be lost.

*There would be a minor boost in the local economy and employment for a three year period.

The disadvantages are important:

*The proposal would require a difficult period of readjustment in three years for employees of the local sawmills when the boomlet ends.

*It now seems unlikely that the present epidemic will kill a great deal of the Lodgepole here after all. But, even if it does, the event would decrease the amount of water used by forest without disturbing soil, having the net result of rendering greater watershed capacity to the forest. And, watershed is the principal value of the national forests in the Intermountain Region.

*It is important not to violate the sustained yield principle of forest management on the national forests, particularly under pressure from industry.

*Economic gains from the timber sale proposals are negligible.

*Economic gains would not nearly compensate for loss of recreational and other values.

a. Replacement of trails with roads results in the introduction of motorized equipment.

b. Piles of logging debris spoil the scene.

c. Disturbance of soil through logging damages both watershed and appearance.

d. Steady enterprise in and dependent upon the lumber industry would be disrupted.

*Opening up the area may be regretted as the need for backcountry recreation increases. Development for timber sales is virtually irreversible.

CONCLUSION

Acceleration of logging on the west side of the Wind River range is not recommended. While such a course of action would result in utilizing a small quantity of timber that might otherwise be destroyed by insects, the economic gain is negligible, and the losses to watershed, to recreation values and to stability of local industry appear to be far greater. The epidemic seems likely to have run its course, and precipitous action now by the Forest Service would very likely be regretted in the future.

CASE STUDY NO. 5

Exhibit 2:

THE BRIDGER CONTROVERSY

During the National Wildlife Federation conference in early March, 1969, a delegation from the Wyoming Wildlife Federation requested a meeting with national conservation organizations to discuss their opposition to forest cutting operations on the Bridger National Forest. Violent objections were raised against past and proposed timber sales along the West face of the Wind River Mountains adjacent to the Bridger Wilderness. Many pictures depicting logging slash, road construction, erosion and other unsightliness were shown and a plea for help was made.

Representatives of the National Wildlife Federation, Izaak Walton League, Wilderness Society, Wildlife Management Institute, and The American Forestry Association present expressed an interest and agreed to look into the situation. A tentative trip to the Bridger in early summer was proposed for Tom Kimball, Joe Penfold and myself to view the problem first hand. During the interim period between March and middle June, this controversy was reviewed by discussion with Forest Service officials and through literature and correspondence furnished both by federal officials and the Wyoming citizens group.

The big problem seemed to be a stepped-up plan for timber harvest because of a serious epidemic of mountain pine beetle in lodgepole pine. Forest Service personnel insisted that accelerated cutting was necessary to help control the beetle and to harvest trees that would otherwise be lost. Local residents objected on the grounds that past cutting had been poorly planned, that regeneration had not taken place, that future cutting would destroy the esthetics of the area, and that this narrow buffer to the Bridger Wilderness should be set aside exclusively for natural beauty and recreation.

A three-day visit (June 25, 26, 27) was made by Brock Evans of the Sierra Club, Bob Herbst of the Izaac Walton League, Tom Kimball of the National Wildlife Federation and me in company with Forest Service officials, Alex Smith and Mike Gaufin of the Regional Office, Supervisors Bill Doshler and Bob Safran of the Bridger and Teton Forests, along with a number of rangers. A three day inspection by car and plane can only be superficial but the trip did give a good bird's eye view of the situation and through the discussions that took place each of us was able to form some opinions that may be helpful. An opportunity for the visiting party to meet with several of the local conservation groups along gave balance to different viewpoints concerning the cutting. The observations and recommendations made here, without any arrangement or priority, are offered in the spirit of friendly cooperation and are not intended to be critical. We hope they may help to resolve the problem in the best interests of all concerned.

1. The mountain pine beetle outbreak is serious and has reached epidemic proportions. However, I saw no effort for direct control except in improved campgrounds. Cutting is proposed in the less infected areas of merchantable timber to break up the forest pattern ahead of the bugs and to harvest mature trees before they are killed. This plan is good if such cuttings are consistent with best overall forest management objectives, but other values may be paramount and prohibit this harvest. Direct control of the bugs should be considered in high recreation value areas. It was successful on the Teton forest where bug infested slopes were destroying the view from the Jackson Lake area.

2. Past mistakes have been made in cutting operations on the Bridger. Cutting blocks have been too big with little or no thought as to their appearance. Regeneration has not been achieved in some areas and incomplete slash removal has left unsightly conditions. At higher elevations there has been past cutting in spruce stands that is questionable. Roads have not been well planned in all cases to prevent erosion, to avoid scarring of the landscape, and to best serve all future uses of the forest. These mistakes and others give real cause for concern by local inhabitants and visitors.

3. The Forest Service is to be commended for its recent improvements in cutting operations. Smaller cutting blocks are well laid out in irregular design and are much less unattractive. Slash disposal is more complete, although not always done as soon as desirable for immediate regeneration. Planting is being used successfully to supplement natural seeding. No cutting is permitted in spruce stands at higher elevations. Logging roads are being planned with an eye to the future.

4. Lacking at the present time on the Bridger is a comprehensive plan for the whole forest with equal attention to recreation that is given to timber management. A recreation-wildlife plan has been submitted to the Regional Office for review, but to the casual visitor to a District Ranger's office emphasis is on timber cutting and insect control. The public will demand more and more priority for public use values on the National Forests and less on timber management. They must be assured that forests not only are managed for multiple uses but that all uses are given equal importance in planning.

5. Opposition to the proposed timber sales is genuine and represents more than the views of a few preservationists. It was repeatedly stated that there was no objection to cutting elsewhere on the forest but only in the lake region and high recreational use areas that served as access to the Bridger Wilderness. There is concern, too, for the change in view from the valley that results from cutting on the lower slopes. The Forest Service is highly respected generally, but it does not appear that there is local support for this cutting program on the forest.

6. There seem to be some animosities between local residents and forest officials. Perhaps this is normal in any controversy that reaches these proportions, but it should be examined. A public relations program

designed to better acquaint local people with forest problems and bring them into the planning is indicated. At least it would be a mistake to go ahead with harvest operations in defiance of local opposition without a thorough public hearing and attempt at justification.

7. The West face of Wind River Mountain range adjacent to the Bridger Wilderness is highly desirable recreation land. It contains many lakes, beautiful views, and productive wildlife habitat. This strip within the National Forest varies in width from less than a mile to not more than eight miles with an average of about three or four miles in depth. Some of this land probably should have been included in the original wilderness designation but all of it, at least, should be managed with high priority for recreational uses and development limited to that which is compatible with the adjacent wilderness. Perhaps the entire unit south and east of the Green River should be designated a National Recreation Area or given some other classification that will insure that public uses are given priority in management.

8. Forest cutting not only is good conservation but often it is esthetically more attractive than no cutting at all. The forest pattern needs to be broken up with openings and different age classes of trees to be most attractive. Tree harvest or even fire are a must for continued high game yields in lodgepole pine type. This can be sold to the public if properly presented but because they don't understand, there is increasing public opposition to any timber harvest. This is the challenge that faces foresters not just on the Bridger but everywhere. More attention must be given to education of the public and consideration of their viewpoints in public land management.

9. The current local market for mature lodgepole pine is slack and there is no pressure from industry to push timber sales on the East Unit of the Bridger Forest. Allowable cut on the Forest far exceeds the average annual harvest in recent years. Other areas of the Bridger probably are sufficient to meet local industry demands. A pulp mill south of the Forest on the Green River has been proposed as an outlet for some of the excess timber in this region. Any current sale likely would be bid in by the distant mill of Dubois and not looked upon with much favor by the people around Pinedale.

On the basis of these few observations made during a much too brief visit and study of the situation, I am going to stick my neck out by making these positive recommendations:

a. Complete the Bridger National Forest Comprehensive Land Use plans as soon as possible.

b. A moratorium on timber sales in the area south of the Green River until district recreation plans are complete and approved.

c. Consideration for making this entire west slope of the Wind River Mountains a National Recreation Area.

d. A careful re-evaluation of any Bridger Forest commitment to a pulp mill at Green River to be sure there is not created more demand for timber than the Forest should deliver. Special attention also should be given to pollution problems that a pulp mill might create.

e. Further emphasis on improved timber harvest techniques with smaller cutting blocks, better slash disposal, quicker regeneration, better road construction and anything else that will make timber sales more pleasing to the local people and to visiting recreationists.

f. An all-out effort toward education and public relations so as to avoid similar such controversies. Bring the local people into district planning. Make them a part of forest administration with a voice in future decisions. Let them know by action and word that the National Forests are managed for all uses and that timber cutting does not have top priority.

g. An attempt should be made to control the pine beetle by spraying or some other method that will cause less damage to recreational values.

APPENDIX B

MAJOR ACTS OF CONGRESS RELATING TO FOREST SERVICE ACTIVITIES

Exhibit 1

CREATIVE ACT OF 1891

Act of March 3, 1891 (26 Stat. 1103) as amended by the Acts of March 4, and June 7, 1924 (43 Stat. 655); 16 U.S.C. 471

Sec. 24. The President of the United States may, from time to time, set apart and reserve, in any State or Territory having public land bearing forests, in any part of the public lands wholly or in part covered with timber or undergrowth, whether of commercial value or not, as national forests and the President shall, by public proclamation, declare the establishment of such forests and the limits thereof.

> Note. -- Acts subsequent to the Creative Act placed restrictions on the authority to create national forests or additions within certain States. See Part 1, "Establishment, Consolidation, and Purpose."

Exhibit 2

ORGANIC ADMINISTRATION ACT OF 1897

Act of June 4, 1897 (30 Stat. 34, 35, 36), as amended by the Acts of June 6, 1900 (31 Stat. 661); February 1, 1905 (33 Stat. 628); June 30, 1906 (34 Stat. 684); March 3, 1925 (43 Stat. 1132, 1144); 1946 Reorg. Plan No. 3, July 16, 1946; 11 F.R. 7876 (60 Stat. 1100); May 27, 1952 (66 Stat. 95); October 23, 1962 (76 Stat. 1157); 16 U.S.C. 473-478, 479-482, 551

Note. -- The following provisions originated as parts of Section 1, of the Sundry Civil Expenses Appropriation Act for Fiscal Year 1898.

The President of the United States is authorized and empowered to revoke, modify, or suspend any and all Executive orders and proclamations or any part thereof issued under authority of the Act of March 3, 1891 from time to time as he shall deem best for the public interests. By such modification he may reduce the area or change the boundary lines or may vacate altogether any order creating a national forest.

Surveys, field notes, and plats returned from the survey of public lands designated as national forests undertaken under the supervision of the Director of the Geological Survey in accordance with provisions of the Act of June 4, 1897, chapter 2, section 1, Thirtieth Statutes, page 34, shall have same legal force and effect surveys, field notes and plats returned through the Field Surveying Service; and such surveys, which include subdivision surveys under the rectangular system, approved by the Secretary of the Interior or such officer as he may designate as in other cases, and properly certified copies thereof shall be filed in the respective land offices of the districts in which such lands are situated, as in other cases. All laws inconsistent with the provisions hereof are declared inoperative as respects such survey. A copy of every topographic map and other maps showing the distribution of the forests, together with such field notes as may be taken relating thereto, shall be certified thereto by the Director of the Survey and filed in the Bureau of Land Management.

All public lands designated and reserved prior to June 4, 1897, by the President of the United States under the provisions of the Act of March 3, 1897, the orders for which shall be and remain in full force and effect, unsuspended and unrevoked, and all public lands that may hereafter be set aside and reserved as national forests under said Act, shall be as far as practicable controlled and administered in accordance with the following provisions. No national forest shall be established, except to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flow, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States; but it is not the purpose or intent of these provisions, or of the Act providing for such reservations, to authorize the inclusion therein of lands more valuable for the mineral therein, or for agricultural purposes, than for forest purposes.

For the purpose of preserving the living and growing timber and promoting the younger growth on national forests, the Secretary of Agriculture, under such rules and regulations as he shall prescribe, may cause to be designated and appraised so much of the dead, matured, or large growth of trees found upon such national forests as may be compatible with the utilization of the forests thereon, and may sell the same for not less than appraised value in such quantities to each purchaser as he shall prescribe, to be used in the State or Territory in which such timber reservation may be situated, respectively, but not for export therefrom. Before such sale shall take place notice thereof shall be given by the said Secretary of Agriculture for not less than thirty days, by publication in one or more newspapers of general circulation, as he may deem necessary, in the State or Territory where such reservation exists. In cases of unusual emergency the Secretary of Agriculture may, in the exercise of his discretion, permit the purchase of timber and cord wood in advance of advertisement of sale at rates of value approved by him and subject to payment of the full amount of the highest bid resulting from the usual advertisement, in quantities to suit applicants, at a fair appraisement, timber and cord wood and other products not exceeding $2,000 in appraised value. In cases in which advertisement is had and no satisfactory bid is received, or in cases in which the bidder fails to complete purchase, the timber may be sold, without further advertisement, at private sale, in the discretion of the Secretary of Agriculture, at not less than the appraised valuation, in quantities to suit purchasers. Payments for such timber to be made to the receiver of the local land office of the district wherein said timber may be sold, under such rules and regulations as the Secretary of Agriculture may prescribe; and the moneys arising therefrom shall be accounted for by the receiver of such land office to the Secretary of Agriculture, in a separate account, and shall be covered into the Treasury. Such timber before being sold, shall be marked and designated, and shall be cut and removed under the supervision of some person appointed for that purpose by the Secretary of Agriculture not interested in the purchase or removal of such timber nor in the employment of the purchaser thereof. Such supervisor shall make report in writing to the Secretary of Agriculture and to the receiver in the land office in which such reservation shall be located of his doings in the premises.

The Secretary of Agriculture may permit, under regulations to be prescribed by him, the use of timber and stone found upon national forest, free of charge, by bona fide settlers, miners, residents, and prospectors for minerals, for firewood, fencing, building, mining, prospecting, and other domestic purposes, as may be needed by such persons for such purposes; such timber to be used within the State or Territory, respectively, where such national forests may be located.

Nothing herein shall be construed as prohibiting the egress or ingress of actual settlers residing within the boundaries of national forests, or from crossing the same to and from their property or homes; and such wagon roads and other improvements may be constructed thereon as may be necessary to reach their homes and to utilize their property under such rules and regulations as may be prescribed by the Secretary of Agriculture. Nor shall anything herein prohibit any person from entering upon such national forests for all proper and lawful purposes, including that of prospecting, locating, and developing the mineral resources thereof. Such persons must comply with the rules and regulations covering such national forests.

The settlers residing within the exterior boundaries of national forests, or in the vicinity thereof, may maintain schools and churches within such national forest, and for that purpose may occupy any part of the said national forest, not exceeding two acres for each schoolhouse and one acre for a church.

The jurisdiction, both civil and criminal, over persons within national forests shall not be affected or changed by reason of their existence, except so far as the punishment of offenses against the United States therein is concerned; the intent and meaning of this provision being that the State wherein any such national forest is situated shall not, by reason of the establishment thereof, lose its jurisdiction, nor the inhabitants thereof their rights and privileges as citizens, or be absolved from their duties as citizens of the State.

All waters within the boundaries of national forests may be used for domestic, mining, milling, or irrigation purposes, or under the laws of the United States and the rules and regulations established thereunder.

Upon the recommendation of the Secretary of the Interior, with the approval of the President, after sixty days notice thereof, published in two papers of general circulation in the State of Territory wherein any national forest is situated, and near the said national forest, any public lands embraced within the limits of any such forest which, after due examination by personal inspection of a competent person appointed for that purpose by the Secretary of the Interior, shall be found better adapted for mining or for agricultural purposes than for forest usage, may be restored to public domain. And any mineral lands in any national forest which have been or which may be shown to be such, and subject to entry under the existing mining laws of the United States and the rules and regulations applying thereto, shall continue to be subject to such location and entry, notwithstanding any provisions herein contained.

The Secretary of Agriculture shall make provisions for the protection against destruction by fire and depredation upon the public forests and national forests which may have been set aside or which may be hereafter set aside under the provisions of the Act of March 3, 1891, and which may be continued; and he may make such rules and regulations and establish such service as will insure the objects of such reservations, namely, to regulate their occupancy and use and to preserve the forests thereon from destruction; and any violation of the provisions of this Act or such rules and regulations shall be punished by fine of not more than $500 or imprisonment for not more than six months, or both.

Exhibit 3

MULTIPLE USE-SUSTAINED YIELD ACT

Act of June 12, 1960 (74 Stat. 215; 16 U.S.C. 528-531)

Sec. 1. It is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. The purposes of this Act are declared to be supplemental to, but not in derogation of, the purposes for which the national forests were established as set forth in the Act of June 4, 1897 (16 U.S.C. 475). Nothing herein shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish on the national forests. Nothing herein shall be construed so as to affect the use or administration of the mineral resources of national forests lands or to affect the use or administration of Federal lands not within national forests.

Sec. 2. The Secretary of Agriculture is authorized and directed to develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained therefrom. In the administration of the national forests due consideration shall be given to the relative values of the various resources in particular areas. The establishment and maintenance of areas of wilderness are consistent with the purposes and provisions of this Act.

Sec. 3. In the effectuation of this Act the Secretary of Agriculture is authorized to cooperate with interested State and local governmental agencies and others in the development and management of the national forests.

Sec. 4. As used in this Act, the following terms shall have the following meanings:

(a) "Multiple use" means the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

(b) "Sustained yield of the several products and services" means the achievement and maintenance in perpetuity of high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.

Exhibit 4

WILDERNESS ACT

Act of September 3, 1964 (78 Stat. 890; 16 U.S.C. 1131-1136)

Sec. 1. This Act may be cited as the "Wilderness Act."

Wilderness System Established Statement of Policy

Sec. 2. (a) In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness. For this purpose there is hereby established a National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas", and these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness; and no Federal lands shall be designated as "wilderness areas" except as provided for in this Act or by a subsequent Act.

(b) The inclusion of an area in the National Wilderness Preservation System notwithstanding, the area shall continue to be managed by the Department and agency having jurisdiction thereover immediately before its inclusion in the National Wilderness Preservation System unless otherwise provided by Act of Congress. No appropriation shall be available for the payment of expenses or salaries for the administration of the National Wilderness Preservation System as a separate unit nor shall any appropriations be available for additional personnel stated as being required solely for the purpose of managing or administering areas solely because they are included within the National Wilderness Preservation System.

Definition of Wilderness

(c) A wilderness in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantiall unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

National Wilderness Preservation System--
Extent of System

Sec. 3. (a) All areas within the national forests classified at least 30 days before the effective date of this Act by the Secretary of Agriculture or the Chief of the Forest Service as "wilderness", "wild", or "canoe" are hereby designated as wilderness areas. The Secretary of Agriculture shall --

(1) Within one year after the effective date of this Act, file a map and legal description of each wilderness area with the Interior and Insular Affairs Committees of the United States Senate and the House of Representatives, and such descriptions shall have the same force and effect as if included in this Act: Provided, however, That correction of clerical and typographical errors in such legal descriptions and maps may be made.

(2) Maintain, available to the public, records pertaining to said wilderness areas, including maps and legal descriptions, copies of regulations governing them, copies of public notices of, and reports submitted to Congress regarding pending additions, eliminations, or modifications. Maps, legal descriptions, and regulations pertaining to wilderness areas within their respective jurisdictions also shall be available to the public in the offices of regional foresters, national forest supervisors, and forest rangers.

Classification. (b) The Secretary of Agriculture shall, within ten years after the enactment of this Act, review, as to its suitability or nonsuitability for preservation as wilderness, each area in the national forests classified on the effective date of this Act by the Secretary of Agriculture or the Chief of the Forest Service as "primitive" and report his findings to the President.

Presidential recommendation to Congress. The President shall advise the United States Senate and House of Representatives of his recommendations with respect to the designation as "Wilderness" or other reclassification of each area on which review has been completed, together with maps and a definition of boundaries. Such advice shall be given with respect to not less than one-third of all the areas now classified as "primitive" within three years after the enactment of this Act, not less than two-thirds within seven years after the enactment of this Act, and the remaining areas within ten years after the enactment of this Act.

Congressional approval. Each recommendation of the President for designation as "wilderness" shall become effective only if so provided by an Act of Congress. Areas classified as "primitive" on the effective date of this Act shall continue to be administered under the rules and regulations affecting such areas on the effective date of this Act until Congress has determined otherwise. Any such area may be increased in size by the President at the time he submits his recommendations to the Congress by not more than five thousand acres with no more than one thousand two hundred and eighty acres of such increase in any one compact unit; if it is proposed to increase the size of any such area by more than five thousand acres or by more than one thousand two hundred and eighty acres in any one compact unit the increase in size shall not become effective until acted upon by Congress. Nothing herein contained shall limit the President in proposing, as part of his recommendations to Congress, the alteration of existing boundaries of primitive areas or recommending the addition of any contiguous area of national forest lands predominantly of wilderness value. Notwithstanding any other provisions of this Act, the Secretary of Agriculture may complete his review and delete such area as may be necessary, but not to exceed seven thousand acres, from the southern tip of the Gore Range-Eagles Nest Primitive Area, Colorado, if the Secretary determines that such action is in the public interest.

Report to President. (c) Within ten years after the effective date of this Act the Secretary of the Interior shall review every roadless area of five thousand contiguous acres or more in the national parks, monuments and other units of the national park system and every such area of, and every roadless island within, the national wildlife refuges and game ranges under his jurisdiction on the effective date of this Act and shall report to the President his recommendation as to the suitability or nonsuitability of each such area or island for preservation as wilderness.

Presidential recommendation to Congress. The President shall advise the President of the Senate and the Speaker of the House of Representatives of his recommendation with respect to the designation as wilderness of each such area or island on which review has been completed, together with a map thereof and a definition of its boundaries. Such advice shall be given with respect to not less than one-third of the areas and islands to be reviewed under this subsection within three years after enactment of this Act, not less than two-thirds within seven years of enactment of this Act, and the remainder within ten years of enactment of this Act.

Congressional approval. A recommendation of the President for designation as wilderness shall become effective only if so provided by an Act of Congress. Nothing contained herein shall, by implication or otherwise, be construed to lessen the present statutory authority of the Secretary of the Interior with respect to the maintenance of roadless areas within units of the national park system.

Suitability. (d) (1) The Secretary of Agriculture and the Secretary of the Interior shall, prior to submitting any recommendations to the President with respect to the suitability of any area for preservation as wilderness --

Publication in Federal Register. (a) give such public notice of the proposed action as they deem appropriate, including publication in the Federal Register and in a newspaper having general circulation in the area or areas in the vicinity of the affected land;

Hearings. (b) hold a public hearing or hearings at a location or locations convenient to the area affected. The hearings shall be announced through such means as the respective Secretaries involved deem appropriate, including notices in the Federal Register and in newspapers of general circulation in the area: Provided. That if the lands involved are located in more than one State, at least one hearing shall be held in each State in which a portion of the land lies;

(c) at least thirty days before the date of a hearing advise the Governor of each State and the governing board of each county, or in Alaska the borough, in which the lands are located, and Federal departments and agencies concerned, and invite such officials and Federal agencies to submit their views on the proposed action at the hearing or by no later than thirty days following the date of the hearing.

(2) Any views submitted to the appropriate Secretary under the provisions of (1) of this subsection with respect to any area shall be included with any recommendations to the President and to Congress with respect to such area.

Proposed modification. (e) Any modification or adjustment of boundaries of any wilderness area shall be recommended by the appropriate Secretary after public notice of such proposal and public hearing or hearings as provided in subsection (d) of this section. The proposed modification or adjustment shall then be recommended with map and description thereof to the President. The President shall advise the United States Senate and the House of Representatives of his recommendations with respect to such modification or adjustment and such recommendations shall become effective only in the same manner as provided for in subsections (b) and (c) of this section.

APPENDIX C

Guidelines Multiple Use Planning
Region 1 U.S.F.S.
Regional Office, Missoula, Montana

Multiple Use Planning Checklist for
TIMBER SALE LAYOUT

I. Timber Inventory - Preliminary
   1. Obtain Aerial Photos of Sale Area and surrounding vicinity
   2. Study photos and identify:
      A. Major timber types and approx. value
      B. Existing roads and access trails
      C. Private land boundaries, mining claims, section lines, fences, range developments, etc.
      D. Rocky areas, drainages, swampy areas, steep hillsides, and insect or diseased killed timber stands, etc.
   3. Study a detailed map of the surrounding area. Should include approx. a 20-mile radius from sale area. Identify:
      A. Major transportation routes
      B. Population centers
      C. Recreation developments - consider:
         a. kind of recreation it furnishes
         b. type of people that use it
         c. what time of year it is used
      D. Scenic, natural and man-made features
      E. Any other man-made features
      F. All proposed locations for recreation, range, timber wildlife and watershed improvements in the "foreseeable" future.
   4. Considering all information obtained in steps 1, 2 and 3, Determine:
      A. Those problems which might arise from this proposed sale.
      B. Using the multiple use concept, determine whether sale is feasible.

II. Field Recon for Final Timber Inventory
   1. Locate approx. private land lines and corners on ground
      A. Establish which private land lines will conflict with cutting units
      B. Determine what surveying notes will be needed
   2. General Recon of sale area considering:
      A. Logger access
         a. rocks, steepness, wet areas, etc.
      B. Existing or proposed man-made features and their location in relation to the merchantable timber
      C. Natural scenic features which logging may conflict with
      D. Consider all resource uses and what effect logging most likely will have on:

        - a. watershed
        - b. recreation
        - c. wildlife
        - d. range
    - 3. Location of probable cutting unit blocks while considering previously attained information
        - A. Data for volume calculation is gotten at this time
        - B. Probable boundaries are drawn on photos in field

III. Study Proposed Block cutting plan and Evaluate effect on Aesthetics

- 1. Establish if sale is located where it will create a high impact on Aesthetics - Factors Considered:
    - A. Proximity to high use areas - The type of use
        - a. what portions of sale are seen from high use area
        - b. will logging noise affect use area
        - c. will dust created by loggers affect use area
        - d. is sale in commercial flight path
        - e. will sale reduce number of wild animals which are seen by recreationists, etc.
    - B. Any previous logging in proposed sale area and what effect did this logging create on Aesthetics
        - a. did people complain about sale detracting from aesthetics
    - C. Does sale area vicinity have unique scenic features
    - D. Can clearcut blocks and roads be made to blend into the surrounding area. Consider these factors:
        - a. what is the timber type and is it tall enough to conceal roads
        - b. are the slopes steep and what is the exposure. This will tell us the amount of cuts and fills needed on roads and whether new vegetation can be established.
        - c. what is the line of sight angle from all the high use areas to the logging area. This will tell us the screening capabilities of the existing timberstand and how cutting blocks will look from a distance
        - d. how many natural openings in the sale area. Roads are easily seen in openings. Also natural openings sometimes indicate severe sites.
        - e. what type of terrain is in the sale area and can the cutting blocks be laid out to conform to this terrain
    - E. General thinking of the surrounding population centers. Do these people depend on the wood industry for their income

IV. Write Multiple Use Impact Report

V. Do necessary I & E Work

- 1. Contact all landowners, residents, business people, clubs, and other interested groups in the local area as well as surrounding cities and towns.
    - A. Fully inform them of proposed plans and multiple use potential for the area.
    - B. Be receptive to their complaints and suggestions while explaining the F.S. position.

C. Use good resource management as a tool for educating the public.

VI. Begin Actual Field work for sale preparation

1. Establish needed land lines and corners on ground

2. Develop a more specific sale layout plan

A. Take pictures of the proposed sale area from all high use areas.

B. Study photos, vertical photos, and contour maps of the sale area.

C. Using the photos, maps and all previously attained knowledge from field recon and office work, complete this optimum plan.

a. project altered slides of different cutting plans which show how the sale area will look from the high use areas after logging. Decide which cutting plans are acceptable in appearance.

3. Study these plans considering aesthetics, watershed, recreation range, wildlife and timber both individually and as a whole.

A. Recognize that aesthetics is a resource that the public wants and it should be given the same consideration as the other 5 basic resources.

a. is the aesthetics of the sale area reduced any and how much? Can we live with this until nature heals the logging scars?

b. are watershed, recreation, wildlife, range or timber values going to be damaged permanently or temporarily and how much can we live with?

c. What are the values gained by logging this sale and what is their long-term effect.

I. Do these values outweigh any adverse effects of reduced aesthetics and/or damaged resource values? To proceed with the sale this answer should be no.

4. Compile a sale layout using the previous considerations as tools to formulate the optimum plan.

5. Mark cutting units and roads on ground as the plan states

A. Small deviations from the plan may occur if all previous values are considered.

CASE STUDY NO. VIII

FIRE ECOLOGY COMPOSITE

by

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Prepared Under a Contract With The
Rocky Mountain Center on Environment
Denver, Colorado

INTRODUCTION

Fire has always played an important role in our forests and brushlands. Even before man appeared on earth, lightning fires probably periodically burned almost every acre on which there was anything to burn (30).

Records show that fires were also set by Indians (50,52,55). They burned to drive game, improve browse for deer and to keep the forests open. In 1887, Joaquin Miller, who was concerned about conservation, described such burning as follows: "In the spring . . . the old squaws began to look about for the little dry spots of headland or sunny valley, and as fast as dry spots appeared, they would be burned. In this way the fire was always the servant, never the master. . . . By this means, the Indians always kept their forest open, pure and fruitful, and conflagrations were unknown." (41). I have concluded that the Indians were wise in their use of fire. At least, my experience has shown the above to be a good procedure (7).

Late in the 19th century people became more concerned about protection and preservation of our forest resources. This led to establishment of the Forest Reserves. Thereafter, one of the first objectives was to bring about adequate fire protection. In a few years, a policy of virtually complete fire exclusion was adopted. This brought on a controversy in California as to the wisdom of such a policy (7,15). Two groups emerged. The first advocated light burning in the spring and fall as a means of reducing fire hazards. They reasoned that such fires would do what the fires set by lightning and Indians had done. Without light burning, forest fuels would eventually build up to such a point that unwanted wildfires would become inevitable. The second group theorized that wildfires could be stopped without much difficulty and advocated virtual fire exclusion as mandatory forest practice. After only meager research by a forestry committee, this theory was adopted by the Forest Service (7). Probably never before nor since has such a major policy gone into effect with so little awareness of the final consequences.

Now, some 65 years later, it appears that the first group was probably correct. The fuels have built up in many places to a point at which some wildfires are virtually impossible to suppress or stop until the weather becomes favorable or the fire runs out of fuel. The Forest Service position has always been the same, however: with more money for equipment, access roads and manpower, the wildfires can be suppressed without much difficulty. Big fires, such as those in California in 1955, which burned 307,113 acres between August 27 and September 13 (58), and the Sundance fire in Northern Idaho in 1967, which destroyed nearly 56,000 acres (59), and was suppressed at a cost of 3.5 million dollars to the Forest Service, are usually followed by a request for more money. And more often than not, additional money is appropriated for fire suppression. The fuels then continue to build up in many places, another big wildfire occurs, and so the cycle goes.

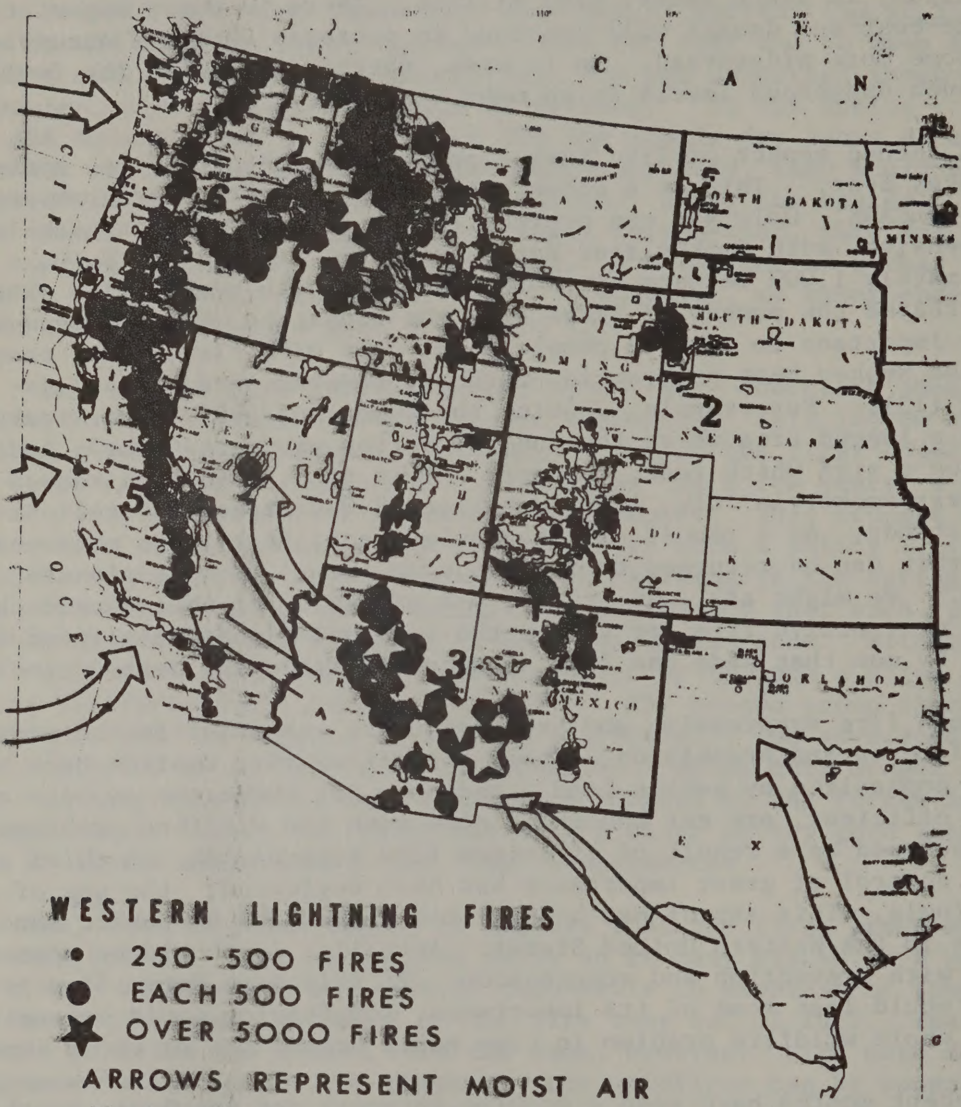
The magnitude of the wildfire problem in general can be illustrated by the situation in California. In 1966, for example, 285,000 acres burned at an estimated cost of $250 million in fire fighting expenses, timber destroyed, flood damage to burned watersheds, recreation facilities damaged, etc. (7). And the unfortunate thing is: a forest tract burned by wildfire may never be returned to its former status. Also, the costs of fire suppression and damage have sky-rocketed. In 1955 this was estimated at $50 million; 12 years later, $250 million. There is every expectation that the cost and damage will continue to increase as fuels accumulate and become more widespread. Is it wise, therefore, to let the fuels build up to such dangerous levels in so many places?

A second aspect of fire exclusion is prevention of fire, symbolized by "Smokey Bear." This is a cooperative fire-prevention program emphasizing "PLEASE! Only you can prevent forest fires." The program is big and expensive, with Smokey Bear Headquarters in Washington, D. C. Approximately 1,000 letters are delivered there each week (22). Since man has increased the number of fires over the landscape, it does seem extremely important to caution people about care with fire. Some people think the Smokey Bear program is overdone, however, and may be misleading (13). For example: During the summer of 1969, after traveling through a logged area where the fuel situation was particularly bad, I came upon a sign which read, in part: "This fire, which was caused by a careless smoker in July, 1960, destroyed 2,000 acres of excellent young timber stands. As a result of one careless act, it will be many years before this can be returned to its place in the . . . multiple-use program." We might ask, was it only one careless act that caused the big and destructive fire, or was it the bad fuel situation allowed to develop by man that made the fire so uncontrollable and destructive?

Both fire suppression and prevention are essential in the management of our forests and brushlands. These aspects of fire control have been greatly emphasized by public land agencies. But these two aspects alone, however efficient, are not enough to cope with the wildfire problems that have developed as a result of efficient fire suppression. A third aspect of fire control of great importance has been neglected: the use of fire to reduce fuels. This aspect has been little emphasized by public land agencies in the Western United States. Actually, it should be placed on a level with prevention and suppression. If this were done, fire prevention would lose some of its importance, suppression would be easier, and the whole wildfire problem in time would become one of minor importance.

Recent months have seen a growing interest and knowledge in the use of fire as a tool to reduce fire hazards (65,67), improve seedbeds for regeneration of certain forest trees, improve the habitat for wildlife and livestock grazing, increase water yields, improve scenic views, and maintain park areas in their natural state. Since this kind of fire is set carefully for a definite purpose, it is known as "prescribed burning."

This and other aspects of fire ecology will be illustrated and discussed in the context of three ecosystems: giant sequoia in the Redwood Mountain grove of Kings Canyon National Park, California; the Selway elk herd management unit on the Nez Percé National Forest in Idaho; and the brushy basin watershed on the Tonto National Forest in Arizona. The primary purpose in using fire will be a little different in each of the three cases. Lightning fires are frequent in all three areas (Fig. 1).



Number of lightning-set forest fires on western National Forests *by Ranger Districts* for 22-year period 1945-1966.

Fig. 1. Occurrence of lightning fires in each of the three study areas. (Courtesy E. Komarek)

1. FIRE ECOLOGY IN GIANT SEQUOIA

The Redwood Mountain grove of giant sequoia is on the western slope of the Sierra Nevada in Tulare County, between elevations of 5,000 and 7,000 feet (Figs. 2 and 3). John Muir explored there in the summer of 1875 and wrote about the superb growth of sequoia: "What a picture it made! In all my wide wanderings I had seen none so sublime. Every tree of all the mighty host seemed perfect in beauty and strength, and their majestic domed heads, rising above one another on the mountain slope, were most imposingly displayed, like a range of bossy, upswelling, cumulus clouds on a calm sky"(57).

a. Environmental Impact of Fire Exclusion

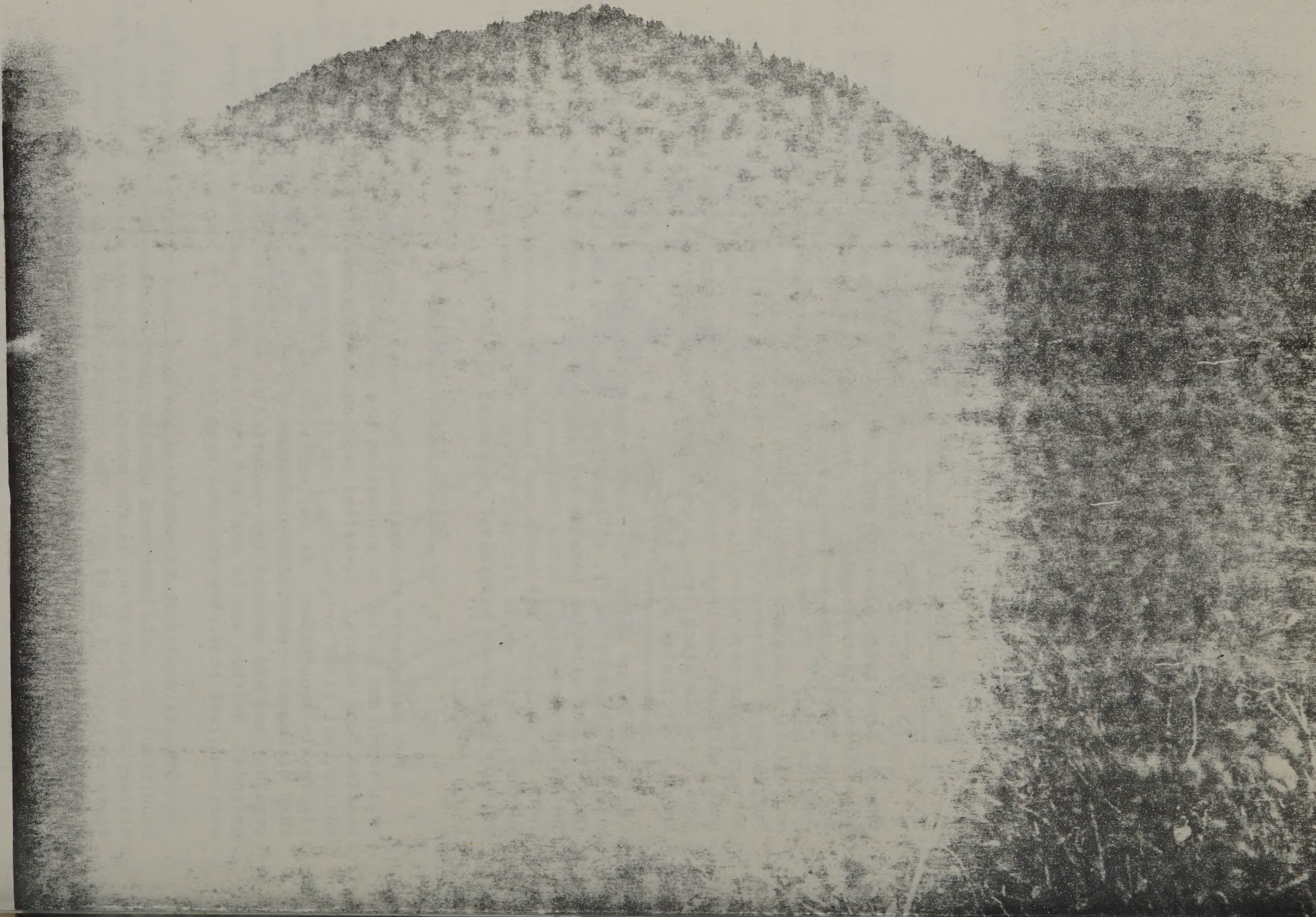
As a result of fire exclusion for approximately 65 years, great changes have taken place in and around the groves of giant sequoia (1,6,9,10, 12). Shade-tolerant white fir trees have increased in number and are blocking out scenic views of giant sequoia (10; Fig. 4). To illustrate the problem (39): In the summer of 1923, a botany professor took two eminent ecologists to a giant sequoia grove to see what one referred to as a "magnificent panorama of columns." Exactly three decades later, in 1953, the professor took his wife and son to view the same prospect and found that, although the trees were still there, the magnificent panorama was gone. In its place, and obscuring it, was a thirty-year growth of young trees, principally white fir.

Debris and white fir have increased to such an extent on Redwood Mountain (Figs. 5, 6, 7, 8) that some areas are almost impassable to man (Fig. 9) and wildfire hazards have increased to dangerous levels (Fig. 10). Shrubs and understory herbs and flowers have all but disappeared. Deer are few. In addition, the humus has become deep and uniform over the soil surface. While white fir will reproduce on the humus layer, giant sequoia will not; it needs mineralsoil seedbeds (23,24,25).

b. Origin of the Problem

For many years the National Park Service managed its lands under a philosophy and policy of protection and preservation. This included protection from natural, so-called destructive phenomena. Thus, under this policy, all fires originating from natural causes, such as lightning, were vigorously suppressed. It was not realized that the natural vegetation they wished to preserve or perpetuate and the natural fires had evolved together and had existed for centuries in nearly perfect harmony and balance. Neither was it realized that the plants and vegetation types were so fixed that they depended upon the fires for survival.

The natural forests were open and park-like. What perpetuated that condition? It could only have been frequent surface fires (5). Some of the history of surface fires in the natural forests was studied by dating fire scars on trees (31,32,61,68). The evidence showed that on the western slope of the Sierra Nevada, fires occurred, on an average, every eight



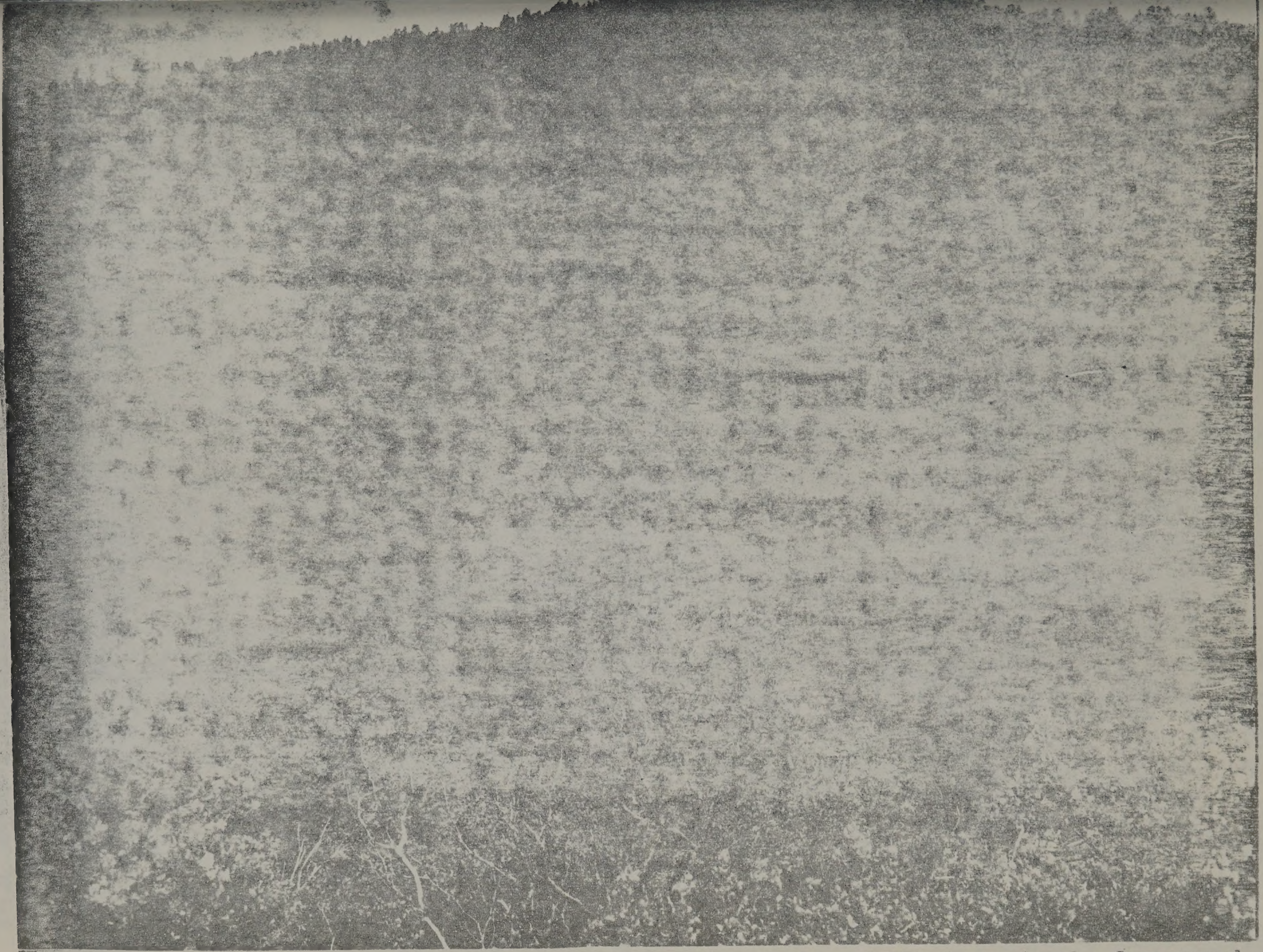
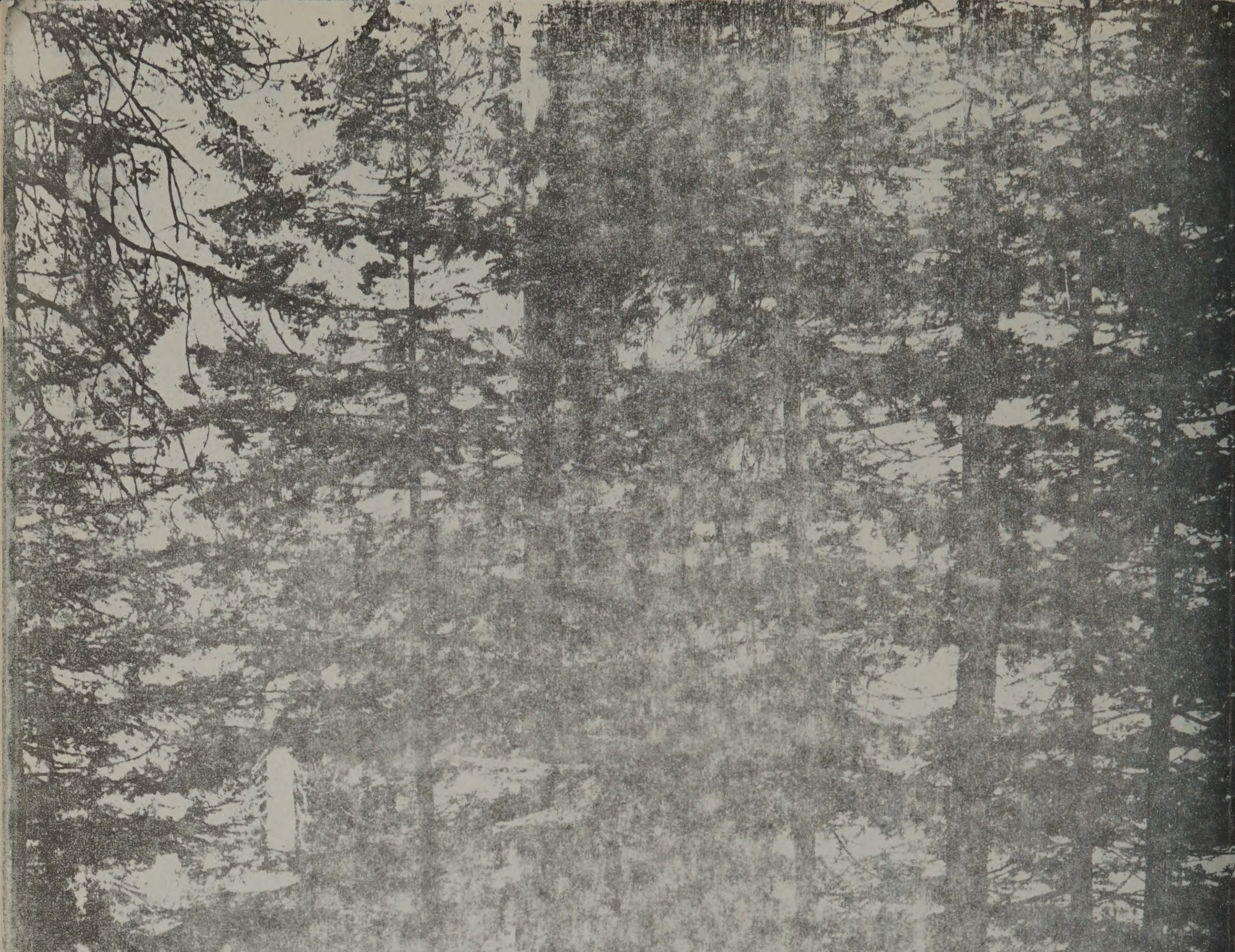
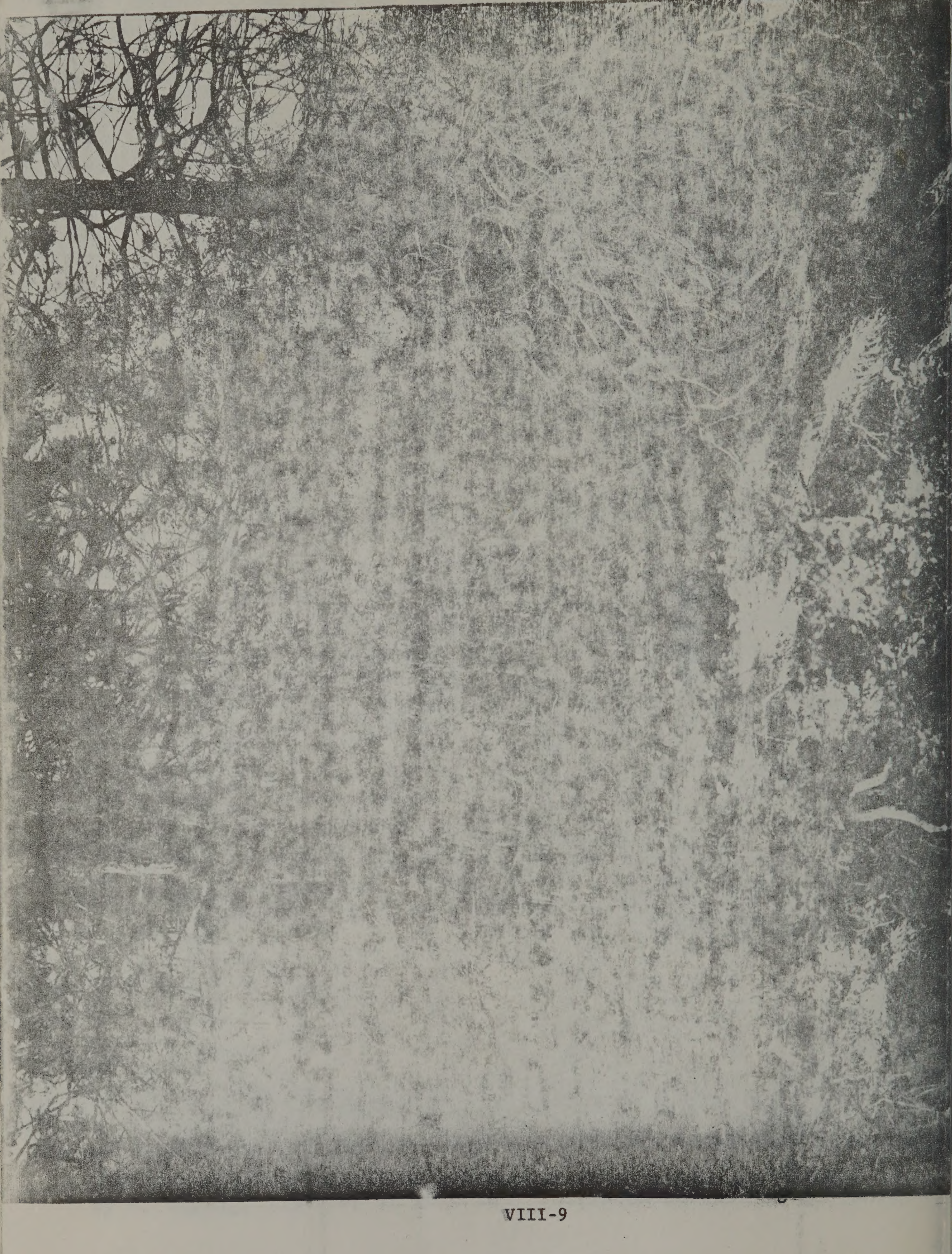


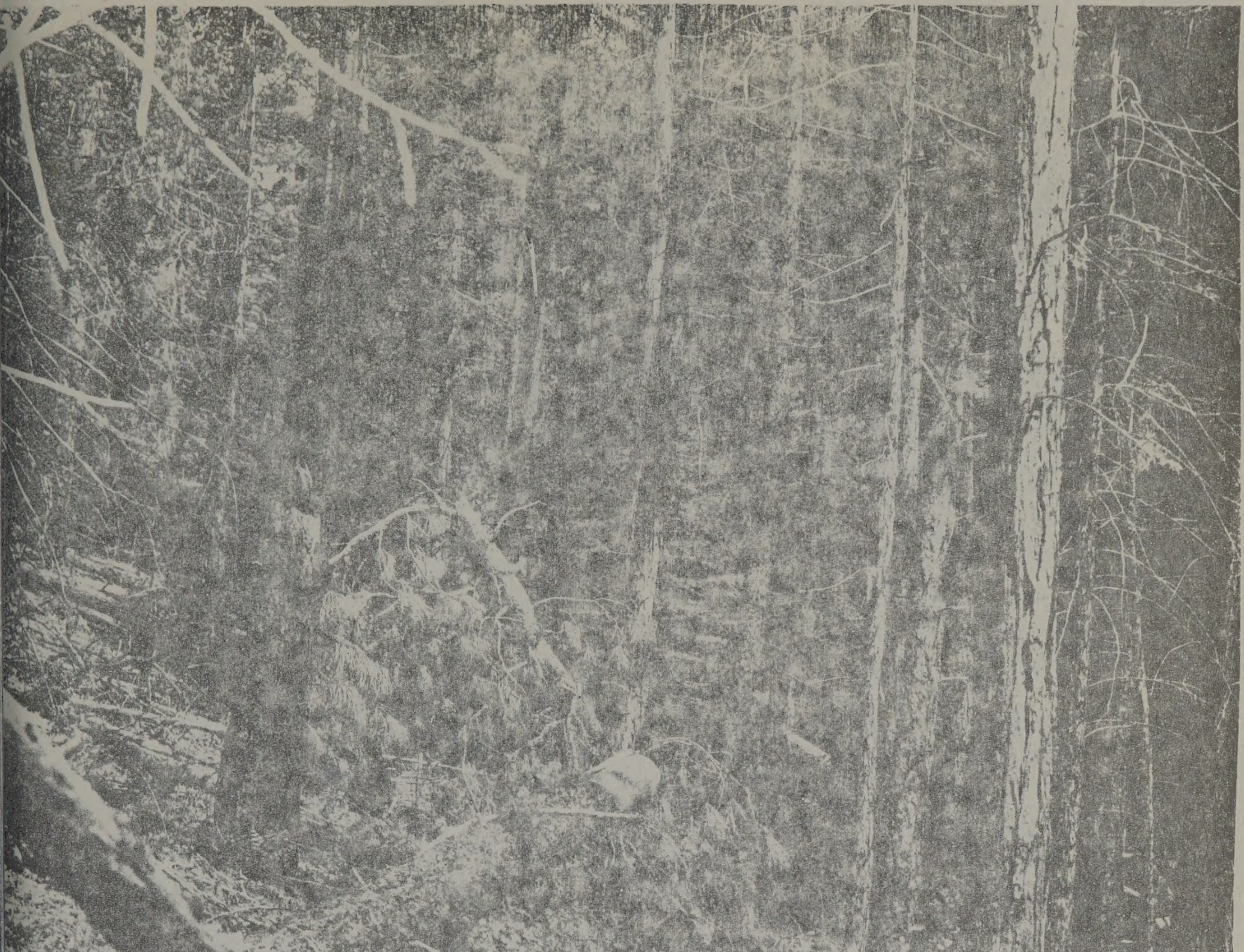
Fig. 3. Southwest slope of Redwood Mountain rises sharply from 4,200 feet, in the foreground, to 7,000 feet and the spectacular sugarbowl group of sequoia at the top.



ig. 4. A magnificent sequoia is only 25 feet from the camera, but can scarcely be seen because of the undergrowth of white fir. (Photo by H. Weaver)

g. 5. A depressing roadside scene on Forest Service lands one mile below the top of Redwood Mountain. (Photo by H. Weaver)





ig. 7. Roadside debris on Forest Service lands on west slope of Redwood Mountain about 1½ miles from the sugarbowl group of sequoia. (Photo by H. Weaver)

ig. 8. Extremely bad fuel situation on west slope of Redwood Mountain. A lightning strike in the dead trees could start a fire that might not be suppressed before it reached the top of Redwood Mountain and destroyed many giant sequoia. (Photo by H. Weaver)

Fig. 9. The combination of white fir and debris makes some areas almost impassable to man. Shrubs and wildflowers are gone and the habitat for deer deteriorated. (Photo by H. Weaver)

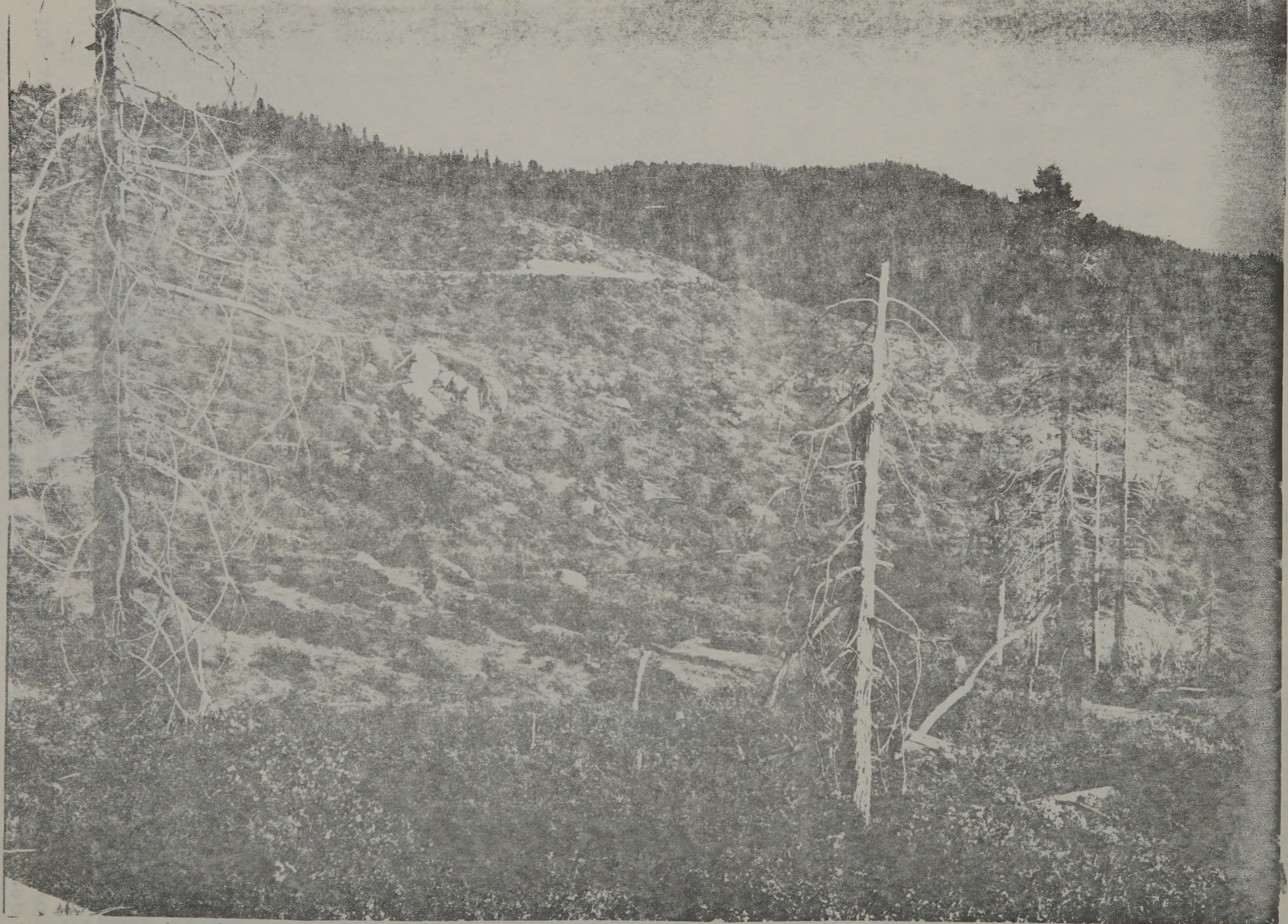


Fig. 10. A wildfire just a few miles north of Redwood Mountain in September, 1955, climbed from foothill woodland through debris-laden ponderosa pine, and along the edge of General Grant grove. It denuded 17,580 acres before it was finally suppressed. Could this same thing happen to giant sequoia on Redwood Mountain? (Photo by H. Weaver)

years from 1685 to 1899. Another study on 74 acres showed 221 distinct fires between 1454 and 1912--one fire about every two years.

Along with climate, soil, and topography, the fires were instrumental in shaping and preserving the pattern of vegetation (16,17,27,28,29,43, 64,66). In the natural forest, a small fuel accumulation resulted from normal forest development, then a light fire reduced the fuel to a "tolerable" level. In this way, the forests found stability and protection against holocausts (51).

Descriptions of fires in natural forests are few, but John Muir, in 1875, described one as it entered a grove of giant sequoia (57):

> But as soon as the deep forest was reached, the ungovernable flood became calm like a torrent entering a lake, creeping and spreading beneath the trees. . . . There was no danger of being chased and hemmed in, for in the main forest belt of the Sierra, even when swift winds are blowing, fires seldom or never sweep over the trees in broad all-embracing sheets as they do in the dense Rocky Mountain woods and in those of the Cascade Mountains of Oregon and Washington. Here they creep from tree to tree with tranquil deliberation, allowing close observation.

Such a statement leads one to question whether John Muir knew of a single case of crown fire in the Sierra Nevada. It is clear, however, that he knew about such fires in other places.

In a recent article on fire ecology, Hartesveldt (23) pointed out that giant sequoia is favored by fire and that in fact, the species could not have evolved or survived as it has without frequent fires. In another article, he and Harvey (25) showed that fires have a qualitative, as well as quantitative, relationship to sequoia regeneration. Surface fires intense enough to remove the humus and expose the mineral soil produce better conditions for seedling survival than do light fires that burn off only the top portions of the humus layer.

In the natural forests, fire was no doubt the most important agent creating suitable seedbeds for giant sequoia (20). But the same surface fires that prepared seedbeds also killed most of the reproduction that followed earlier fires (Fig. 11). The seedlings that had the best chance of surviving were those in moist places and in open spots least subject to the spread of fires (2). In the open spots the seedlings were protected by the lack of fuels to carry fire; thus the natural forests developed in even-aged stands, in groups. It was virtually impossible for these forests to burn by crown fires (53).

c. Environmental Considerations and Alternatives

(1) Considerations

When Stewart Udall was Secretary of the Interior, he appointed a committee, chaired by A. Starker Leopold, to consider and recommend what should be done about wildlife in the national parks (35,36). The committee suggested:

> As a primary goal, we would recommend that the biotic associations within each park be maintained, or where necessary, re-created as nearly as possible in the condition that prevailed when the area was first visited by the white man. A national park should represent a vignette of primitive America.

Shortly thereafter, the National Park Service modified its policy, so that natural fire is now recognized as one of the ecological factors contributing to the welfare of the plants and animals native to a given habitat (44). Accordingly, the Park Service has started an action program in giant sequoia on Redwood Mountain to reintroduce surface fires into the environment. As of January 1, 1970, some 5,000 acres have been burned under careful control.

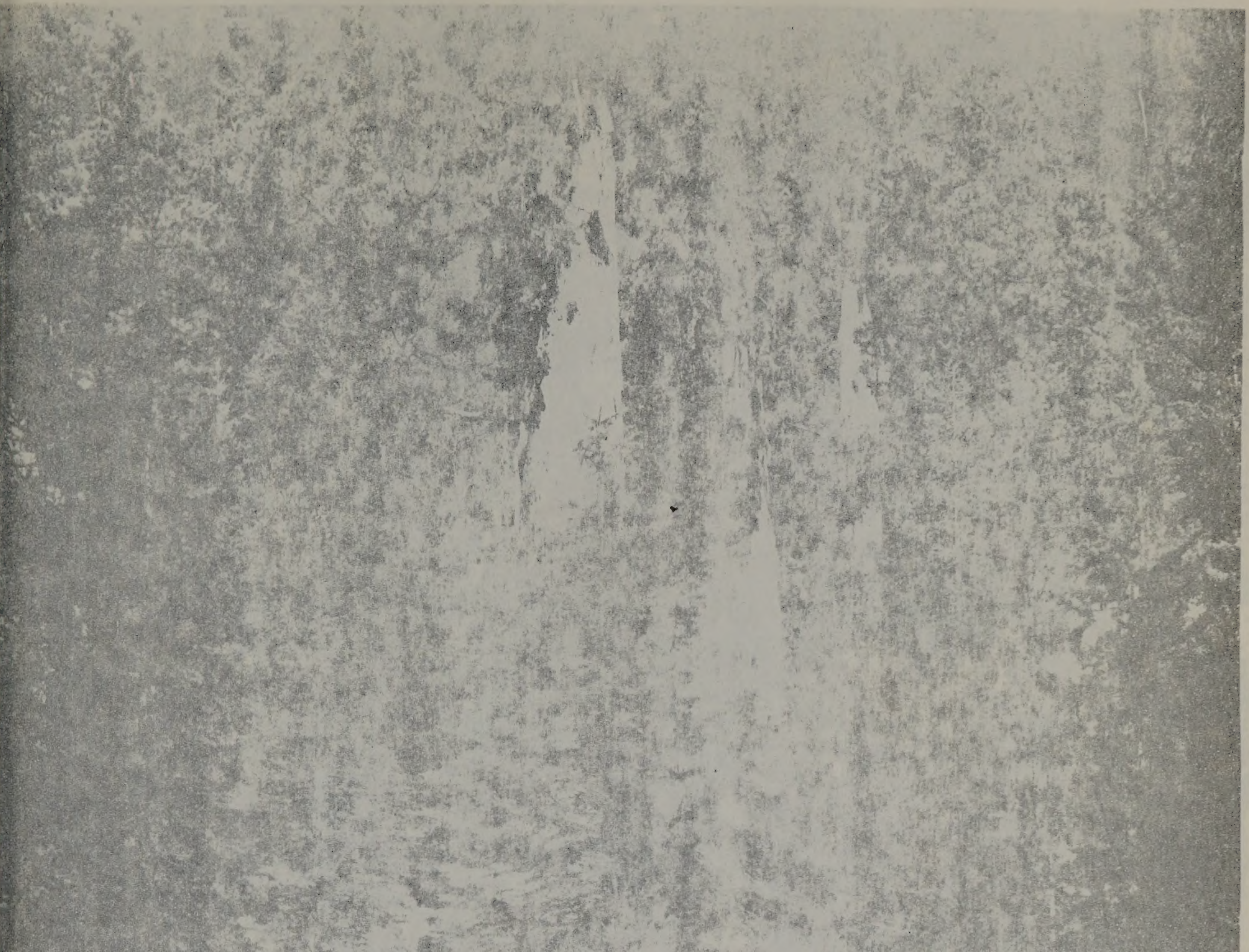
In some places the fires are set on or near ridgetops and permitted to burn in a natural fashion (Figs. 12, 13, 14, 15). The cost is probably not more than $5 per acre. In other places the fuels are reduced by cutting, piling, and burning (Figs. 16 and 17). This management practice is expensive ($50 to $150 per acre), but the operation corrects bad conditions that have developed over a period of many years, and creates a condition whereby natural lightning fires can be permitted to burn (11; Fig. 18). Looked at in these terms, the operation appears less expensive.

The National Park Service has initiated extremely important policy in reintroducing fire as a natural agent in the park environments, where it will be useful in restoring the pattern of vegetation that existed when the parks were established. The final result will be low fire hazards, scenic views of magnificent trees (Figs. 19 and 20), more deer and a ground carpet of wildflowers.

(2) Alternatives

There is no reasonable alternative to prescribed burning, since the humus is continuous under the trees and cannot be removed satisfactorily by other means. All other treatments disturb the soil in an unnatural way and accelerate soil erosion.

Alternatives to prescribed burning have been tried on Forest Service lands ever since fire-exclusion policies were adopted, but fuels have continued to build up in many places. Wildfires have become more and more destructive and costly (8); soil erosion has increased as a result of roads and other practices that create bare soil. This is not to say that fire prevention and suppression on public lands should be relaxed. Rather,



ig. 11. Dense understory of giant sequoia that started after a wildfire. In the natural forest, lightning fires would have destroyed most of this and kept the forest open and park-like. (Photo by H. Weaver)

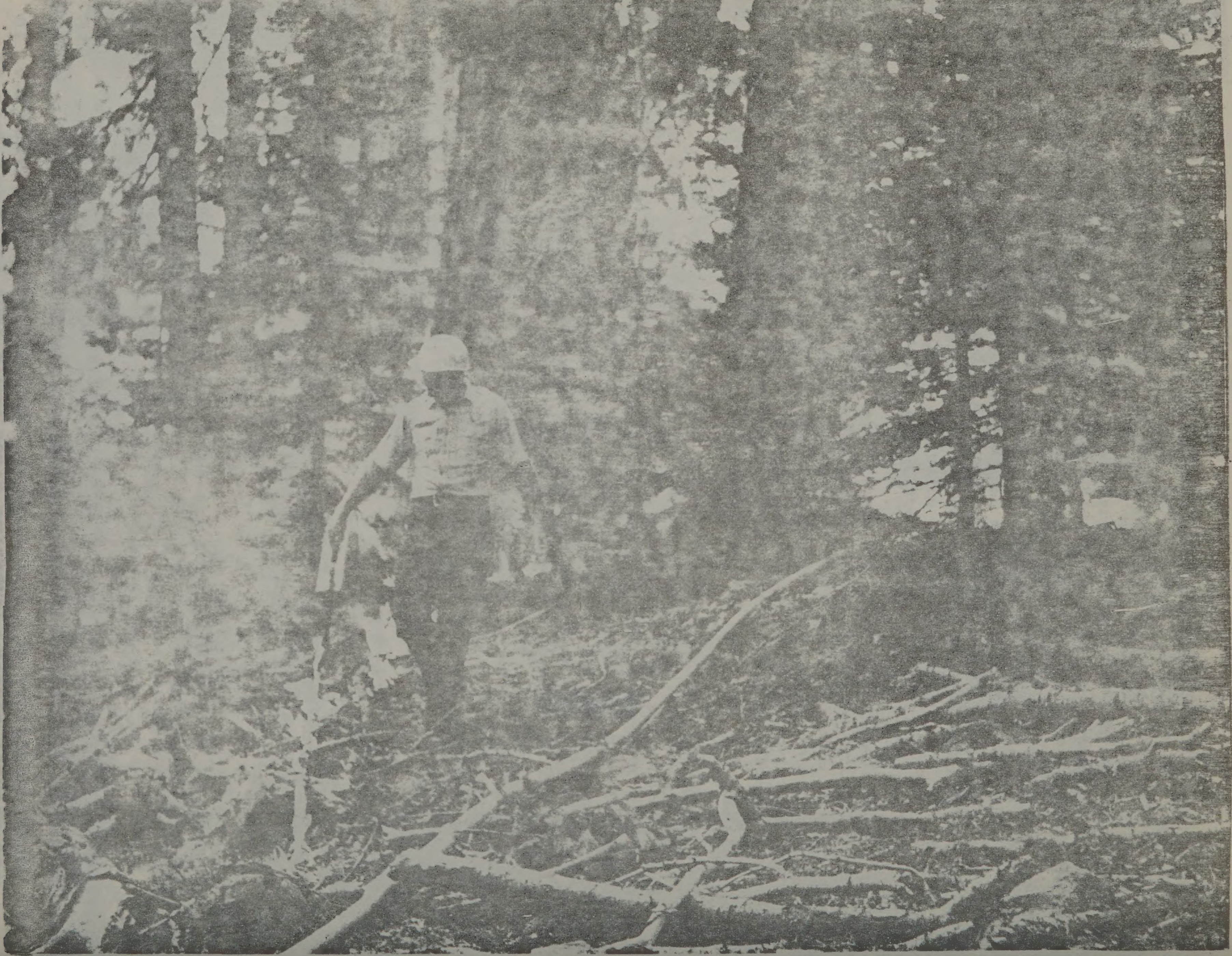


Fig. 12 Chief Park Ranger, Peter H. Schuft, doing prescribed burning in giant sequoia in

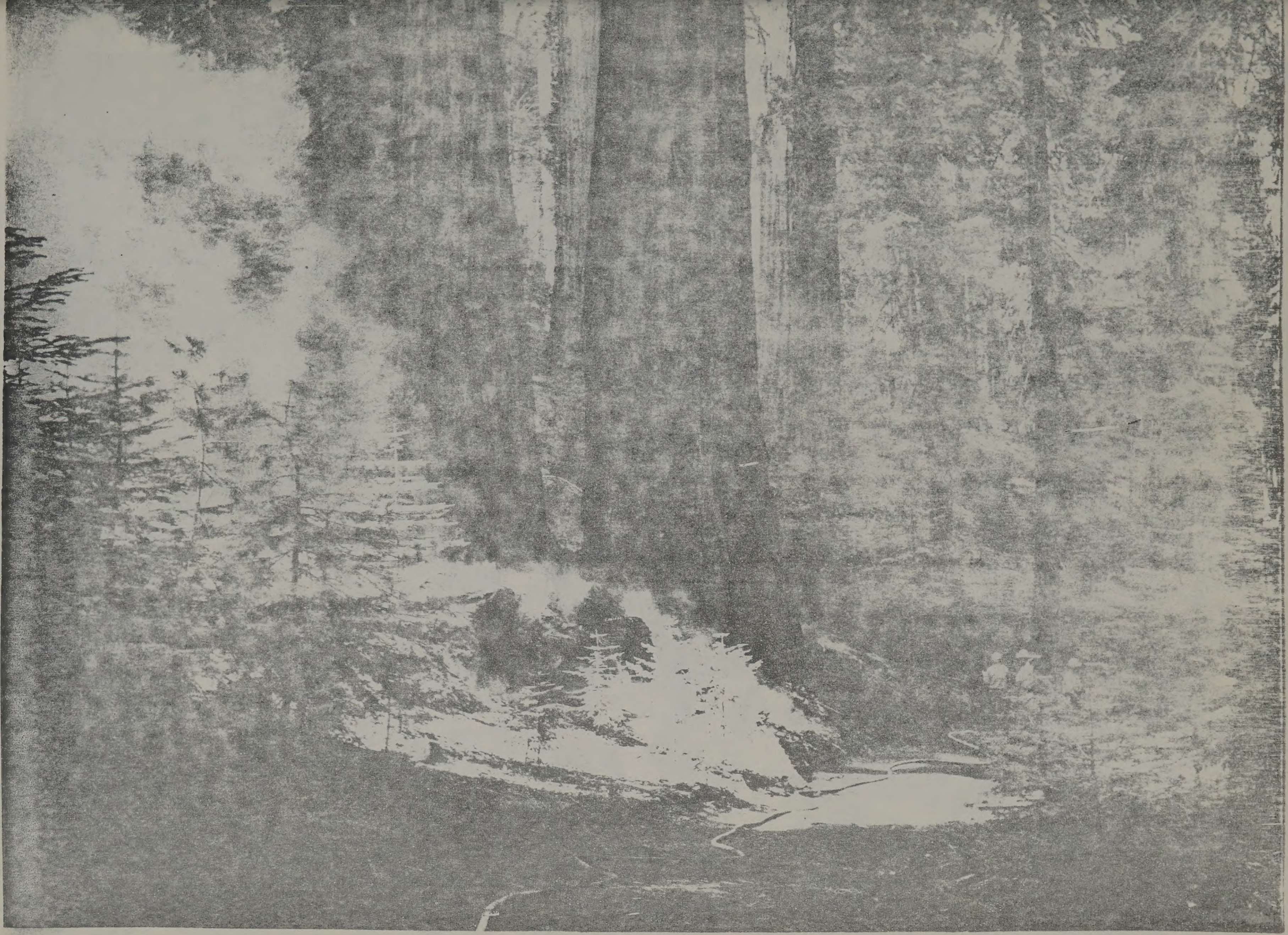


Fig. 13. Prescribed burning near the ridgetop on Redwood Mountain. (National Park Service photo by Bruce M. Kilgore)

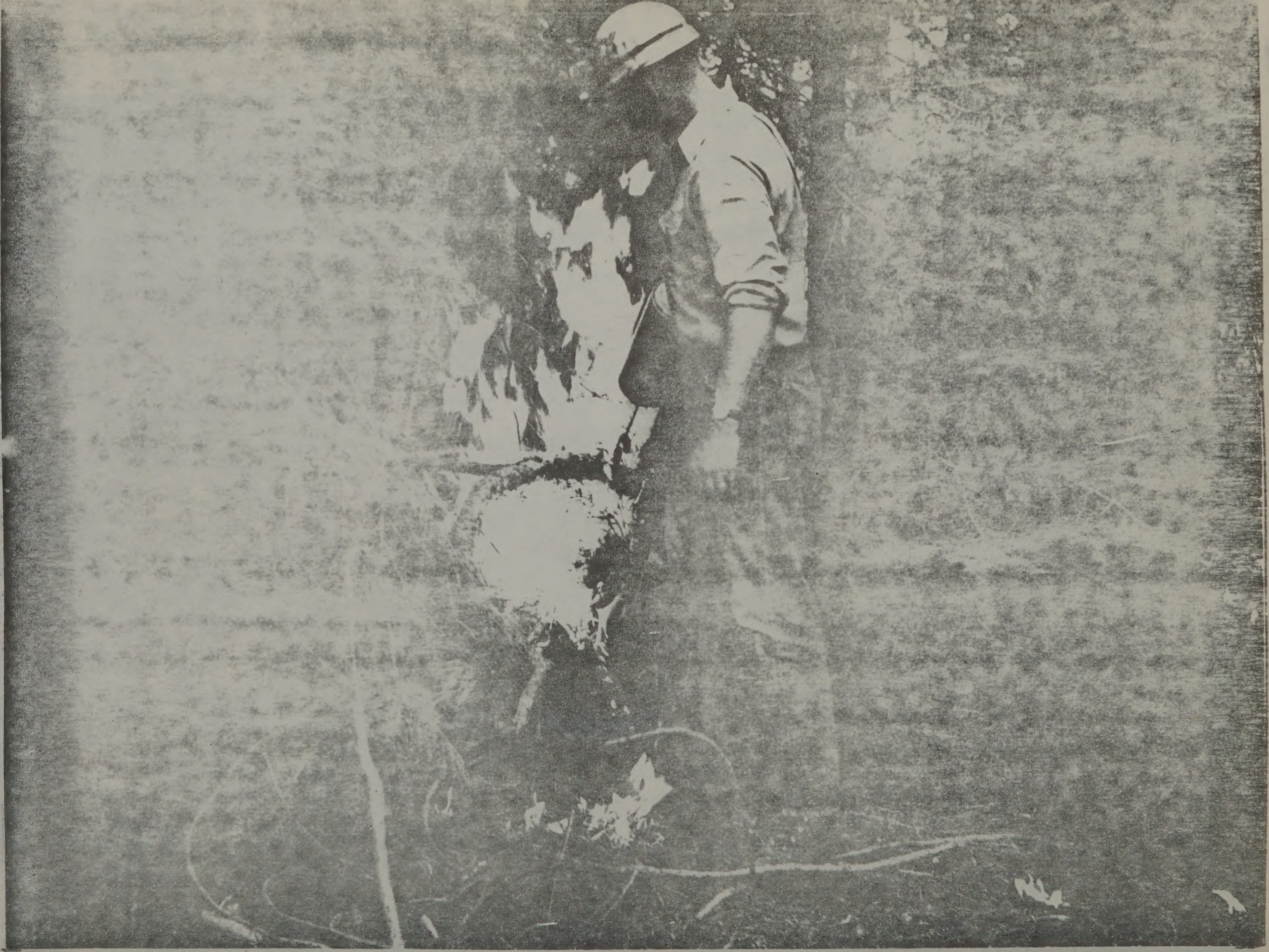


Fig. 14. Setting fire in dense white fir in the Redwood Mountain grove of Kings Canyon National Park. A giant sequoia only a few feet away is almost obscured by the undergrowth.

. 15. Under natural conditions a creeping surface fire would burn the redwood debris and prepare a mineral seedbed for new reproduction. Without fire the debris would probably last for thousands of years: the wood is decay resistant. (Photo by H. Weaver)

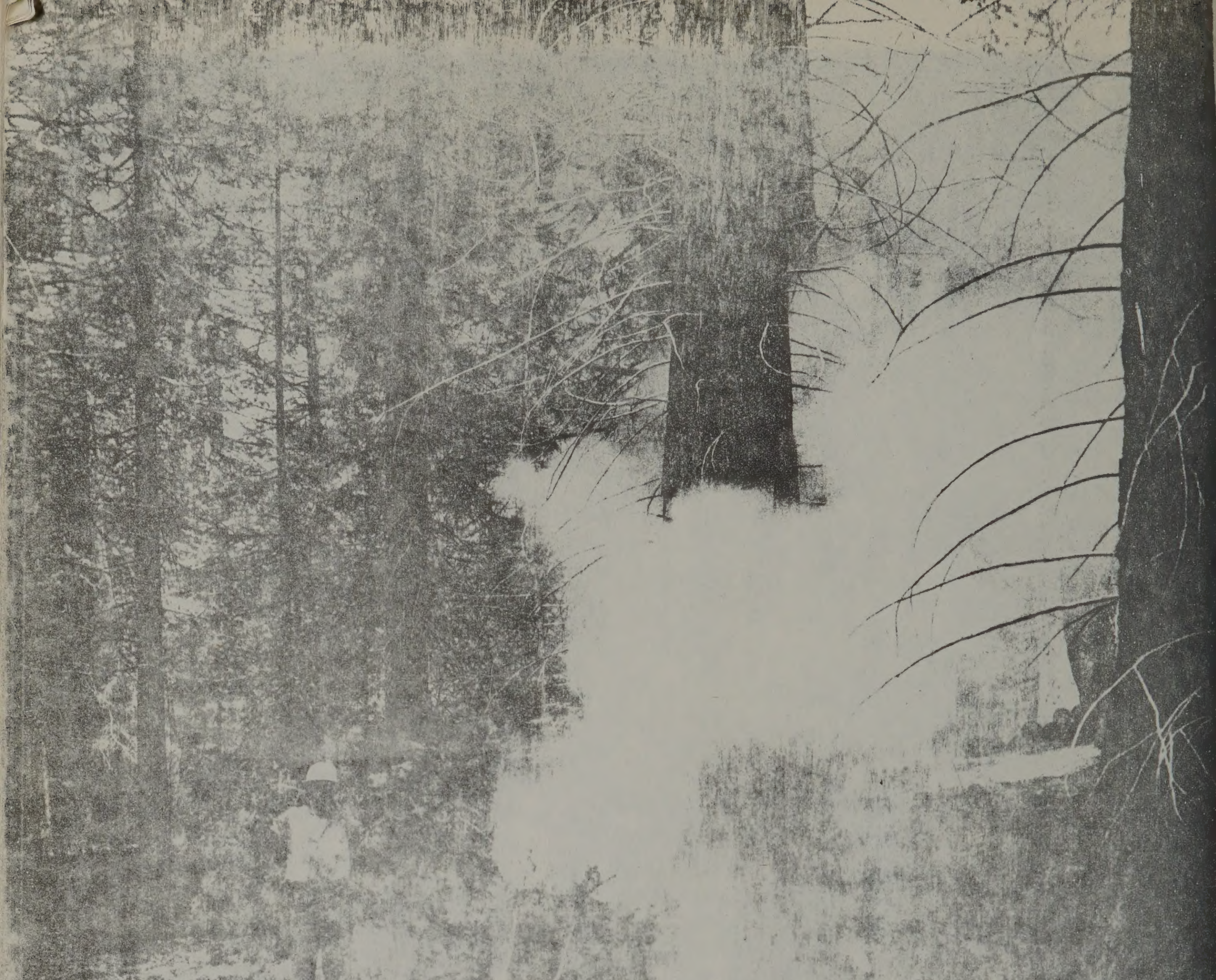
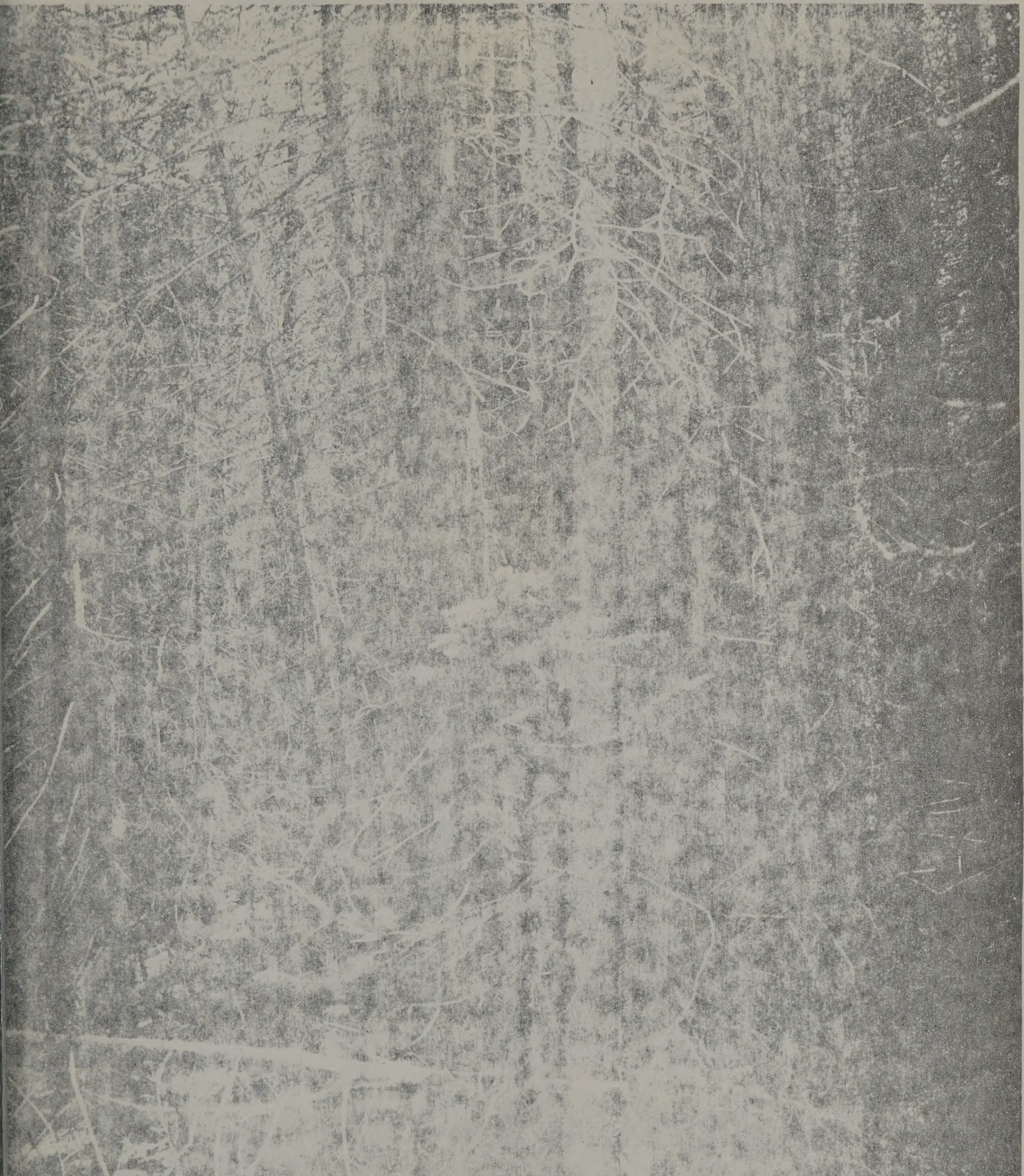


Fig. 16. Member of a conservation crew reducing fuels on Whitaker's Forest on the west slope of Redwood Mountain immediately below the boundary of Kings Canyon National Park. (Photo by H. Weaver)



17. In reducing the fuels in this area, 550 standing dead trees, 945 shade-tolerant white fir and incense-cedar, and 44,040 pounds of debris per acre were removed at a cost of $145 per acre. (Photo by H. Weaver)

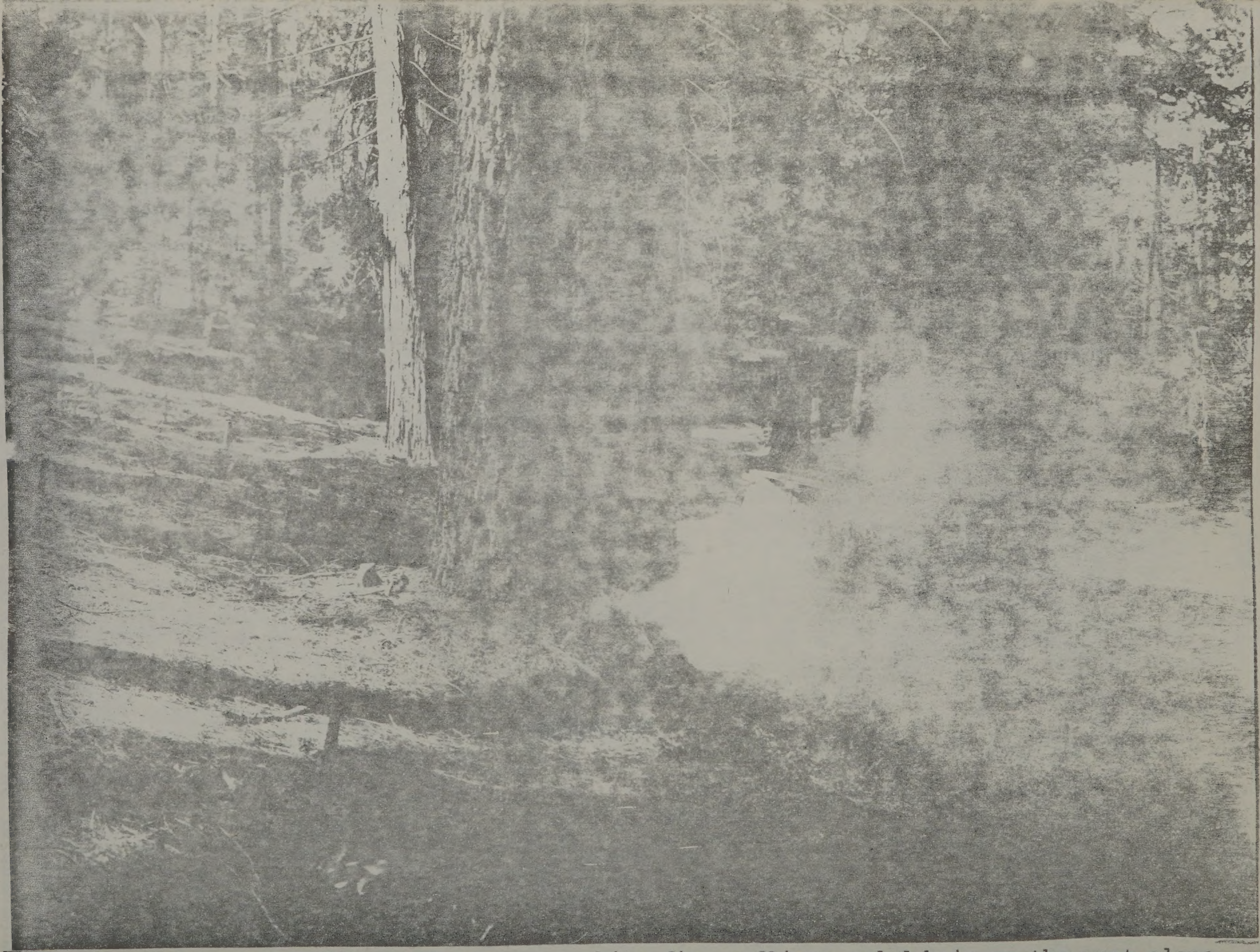
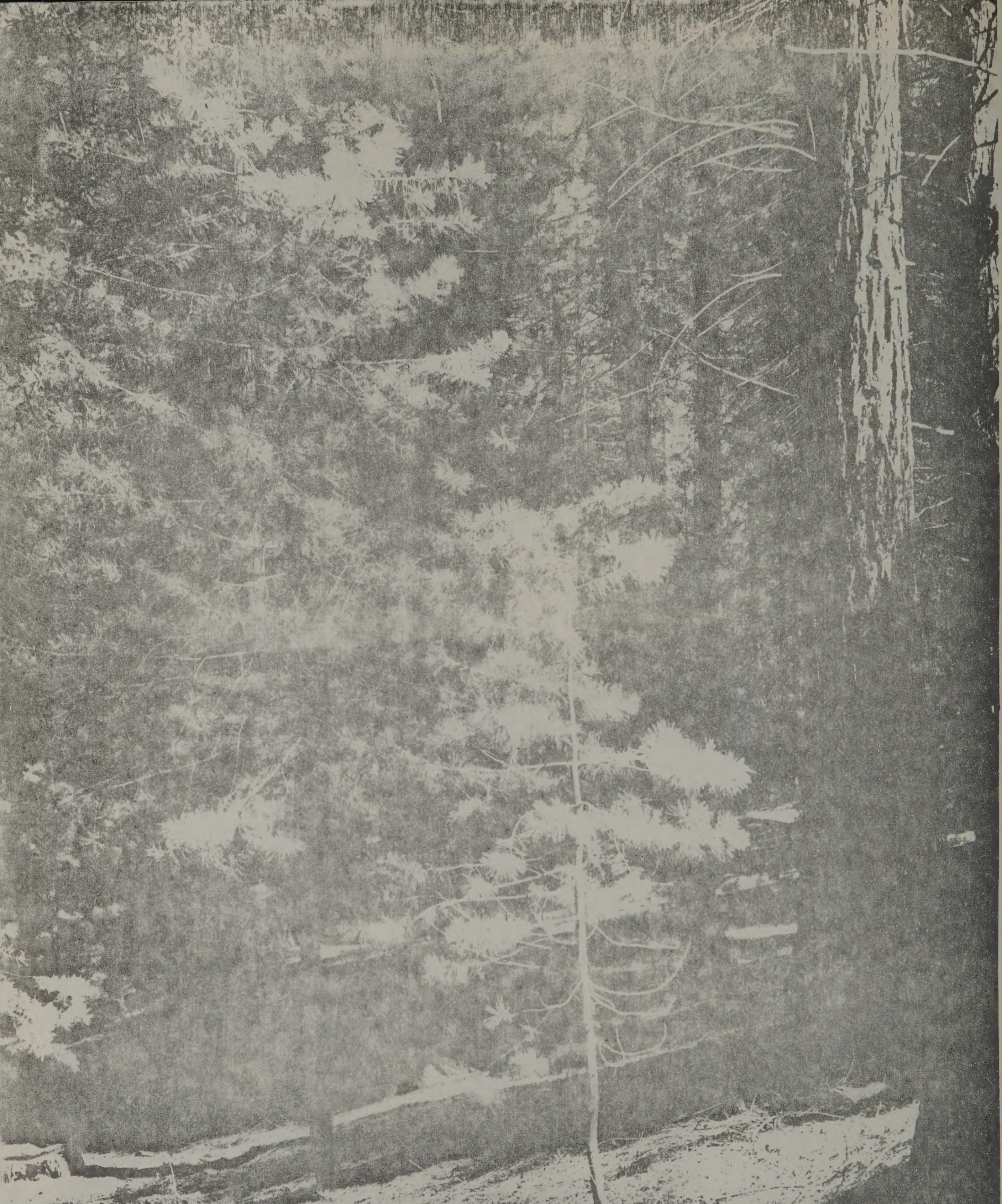


Fig. 18. Light surface fire used to remove white fir seedlings and debris on the west slope of Redwood Mountain. (Photo by H. Weaver)

19. Quality environment restored. An open, park-like forest of giant sequoia with low wildfire hazards and spectacular scenic views of magnificent trees. More sunlight on the forest floor increases ground cover and the quality of forage and browse for deer. (Photo by H. Weaver)



. 20. A scenic view of sugar pine, one of the principal associates of giant sequoia. (Photo by H. Weaver) it does indicate that greater attention must be given to the use of fire as a measure to reduce fire hazard and restore the quality of each forest environment. Prescribed fire is the most natural, safe, and economical way to achieve low fire-hazard conditions. This aspect of fire control needs to be emphasized more by public land agencies.

Prescribed burning does create another problem -- it contributes to air pollution. Wood smoke reduces visibility to some extent, and no one wants smoke, but it contributes relatively little to the noxious chemical elements in smog (19). Conceivably, state and federal laws could be passed to prohibit all burning in forests and brushlands. If this should happen, a mistake will be made as big as that which virtually excluded all fires on public lands. Unless the fuels are reduced, the forests will probably burn down, creating more smoke as well as polluted streams and lakes from accelerated soil erosion.

2. SELWAY ELK HERD MANAGEMENT UNIT

The Selway elk herd management unit is one of three on the Selway district of the Nez Perce National Forest in north central Idaho. The mature forest is a dense stand of conifers: western red cedar, grand fir, Douglas fir, western hemlock, and western white pine (33,34,37). In forests of this type, browse and forage are scarce, and big-game populations are small (Fig. 21).

Lightning fires are exceptionally frequent in north central Idaho (Fig. 1). The natural forests have depended upon such fires, of low intensity, for survival. After settlement of the area and introduction of mining activities, forest fires became intense (42). Over the Selway elk herd management unit, wildfires were particularly severe in 1910, 1919, and 1934 (45). Of the approximately 2,200 square miles in the unit, about 38 percent of the acreage has burned severely and now supports a shrub cover.

a. Impact of Wildfires on Forest Environment

The same intense fires that destroyed the coniferous forests created ideal conditions for the growth of grasses and shrubs (69; Fig. 22). The shrubs soon predominated and became an important source of browse for big-game animals (33,34). The shrubs include Scouler willow, mountain maple, bitter cherry, serviceberry, and redstem ceanothus -- the latter by far the most valuable for browse. This species seldom grows out of reach of browsing animals; it is palatable and high in protein; its root nodules contain nitrogen-fixing bacteria (26).

With the new growth of shrubs, herds of big-game animals began to build up and reached a peak in about 1957, when a census showed a count of 6,774 elk and 569 deer on the Selway management unit (45). In more recent years, the big-game populations have been rapidly declining, creating a problem for the Idaho Department of Fish and Game, responsible

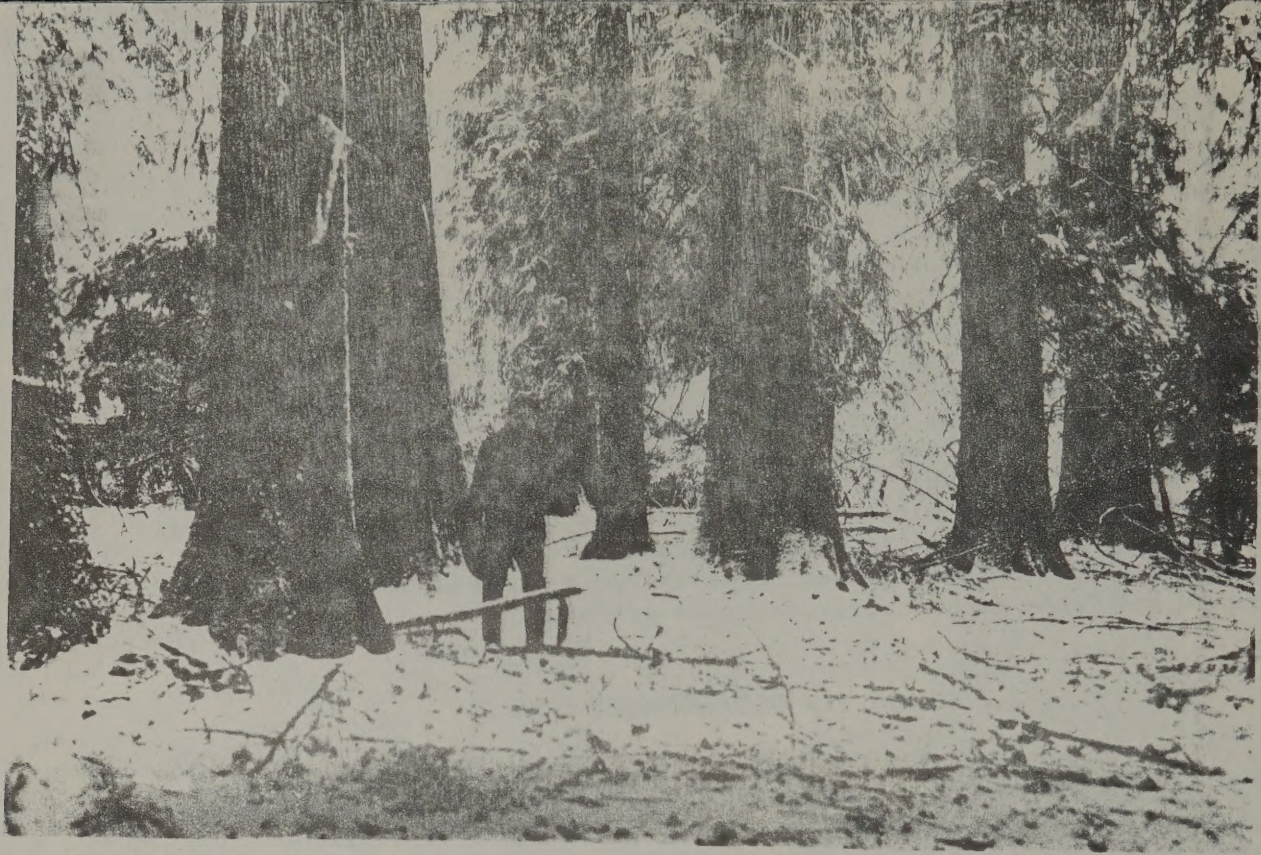


Fig. 21. A natural forest of western red cedar and other conifers in north central Idaho.

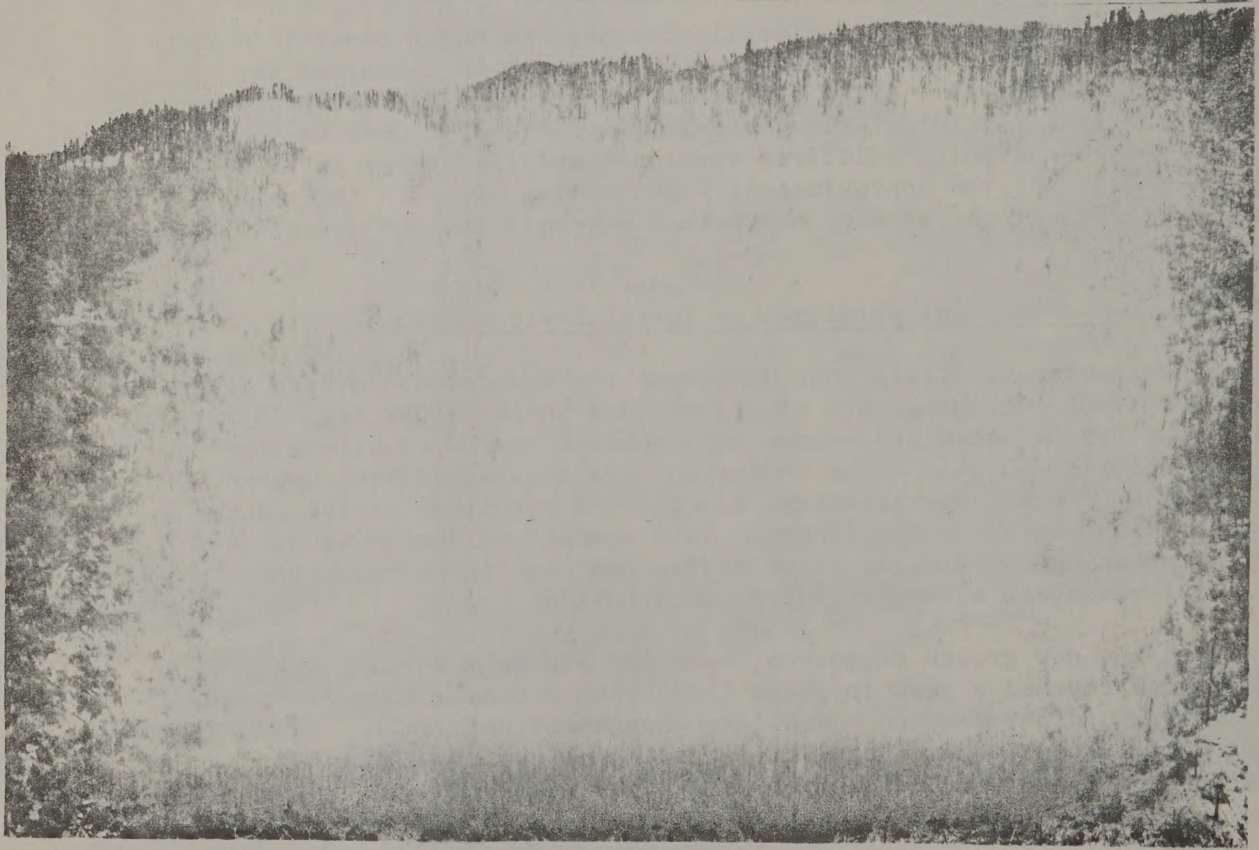


Fig. 22. Intense wildfires in 1910, 1919, and 1934 destroyed most of the conifers and created ideal conditions for elk and other big-game animals.

for wildlife management as well as for the Forest Service in its multiple-use management program.

b. Origin of the Problem

The available browse has been steadily diminishing. Some shrubs have grown tall and out of reach (Fig. 23). Redstem ceanothus has suffered because of shading and root competition from the taller species, and also from heavy browsing as the other species have grown tall (40,46). The nutritional quality of browse has declined with increased shading (34). In some places conifers are invading and thickening in the stands of shrubs.

c. Environmental Considerations and Alternatives

(1) Considerations

Obviously, restoration and maintenance measures must be taken if big-game animals are to remain an important multiple-use resource in this area. The deteriorating browse problem is greatest near the rivers where snow forces animals to go during winter (Figs. 24 and 25).

Prescribed burning was initiated by the Forest Service in 1965 to reduce the height of shrubs and to increase sprouting, palatability, and nutritional qualities of the browse (4; Fig. 26). As a result, single plants of some shrubs now produce as many as 120 new sprouts; palatability has increased significantly (all species on the burned areas are eaten to a much greater extent); protein content is consistently higher; most of the sprouts are now within reach of the browsing animals.

Since 1965, burning has been continued in the Selway ranger district, with 2,276 acres burned in 1966; 2,495 in 1967; 4,652 in 1968; and 7,700 planned for 1969. The burning in 1968 was done at a cost of 71 cents per acre (34).

Burning is best done in the spring before new growth starts. Usually snow is still on the upper slopes. On clear, dry days, the fire is simply set at the foot of a slope near the river and permitted to burn uphill until it reaches the forest or snowline above. Bracken fern, the fuel that carries the fire, will burn under conditions that do not permit fire to burn into the forest. The fire burns near the soil with enough intensity to girdle the tall shrubs, thus creating new sprouts. The soil is moist, and light debris remains on the ground. Observations have shown soil erosion to be minimal or non-existant. Within two or three weeks new growth appears, and the burned areas are no longer noticeable to tourists.

On the Selway elk herd management unit only $533 has been allocated for prescribed burning during the 1970 season. This is an unreasonably small amount in view of the fact that the winter range is large and most of it is steadily deteriorating. It is recommended that allocation of money

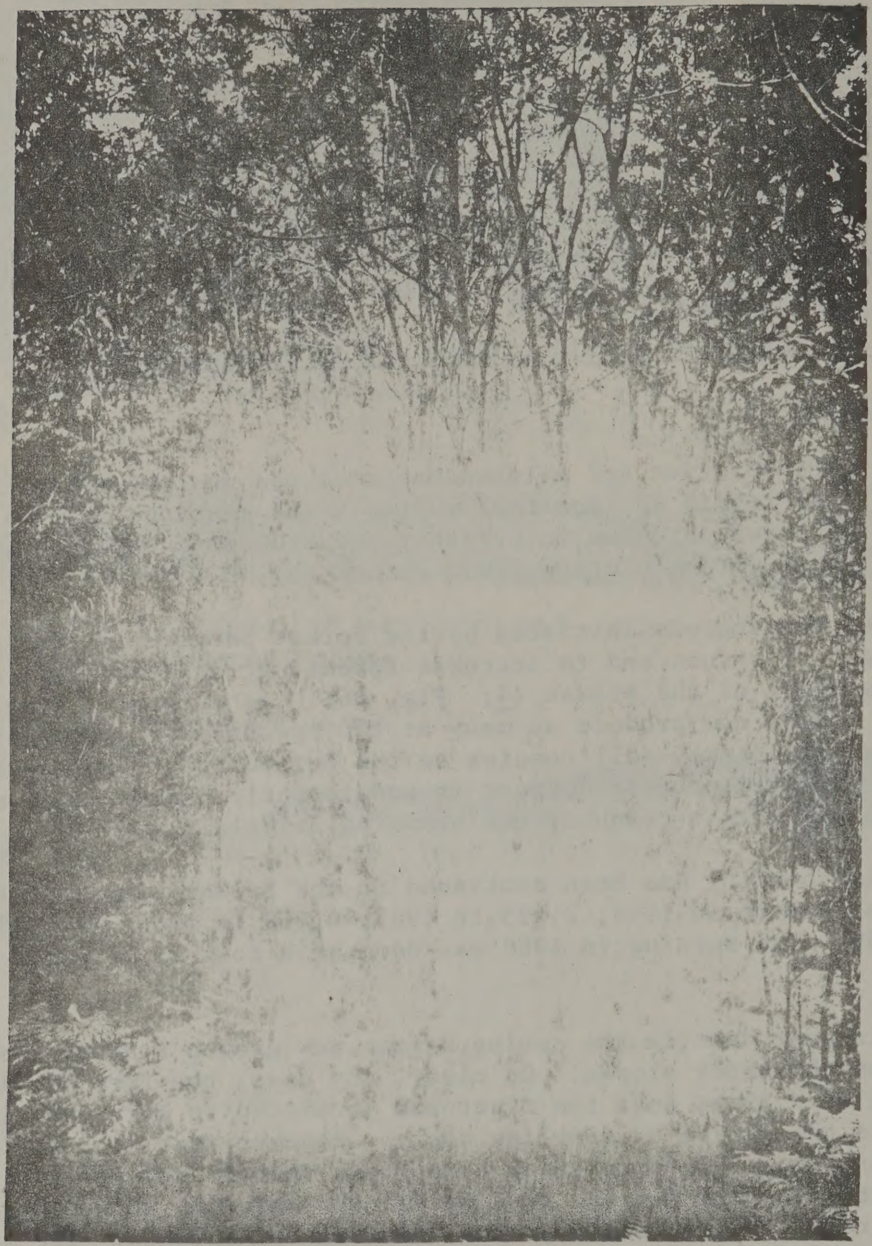


Fig. 23. The browse available to big-game animals diminishes as the shrubs grow tall. The understory of bracken fern serves as fuel in prescribed burning. (Courtesy T. Leege)

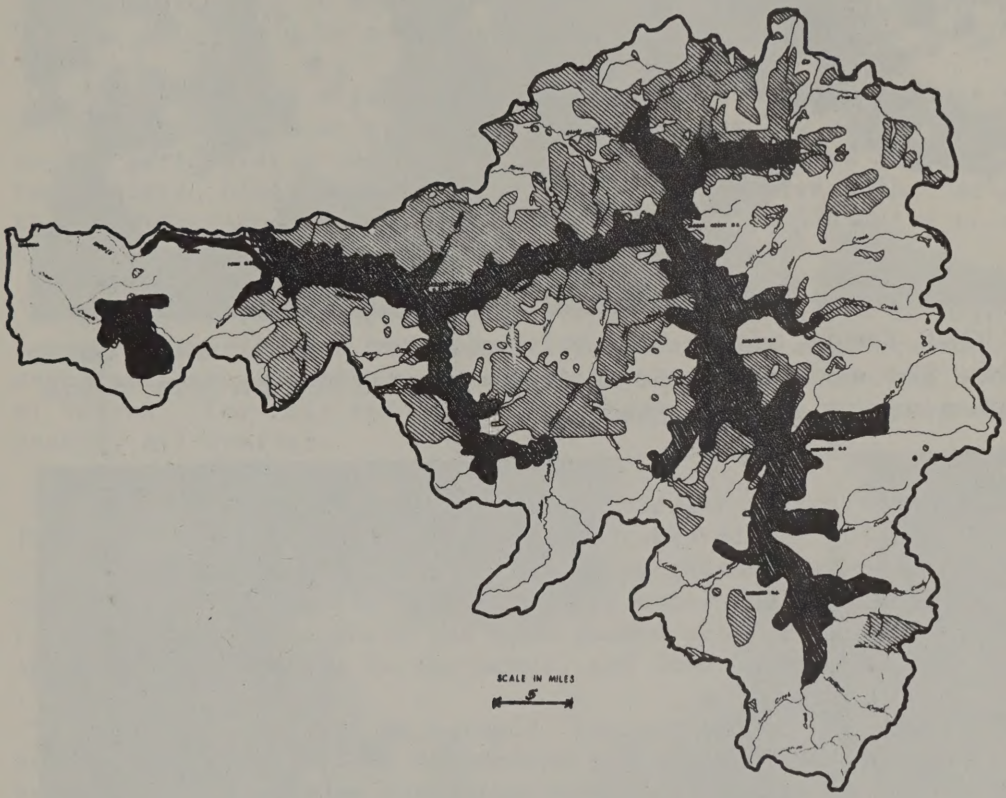


Fig. 24. The Selway elk herd management unit, showing the winter range (dark) along the river and the areas burned (shaded) by wildfires in 1910, 1919, and 1934.

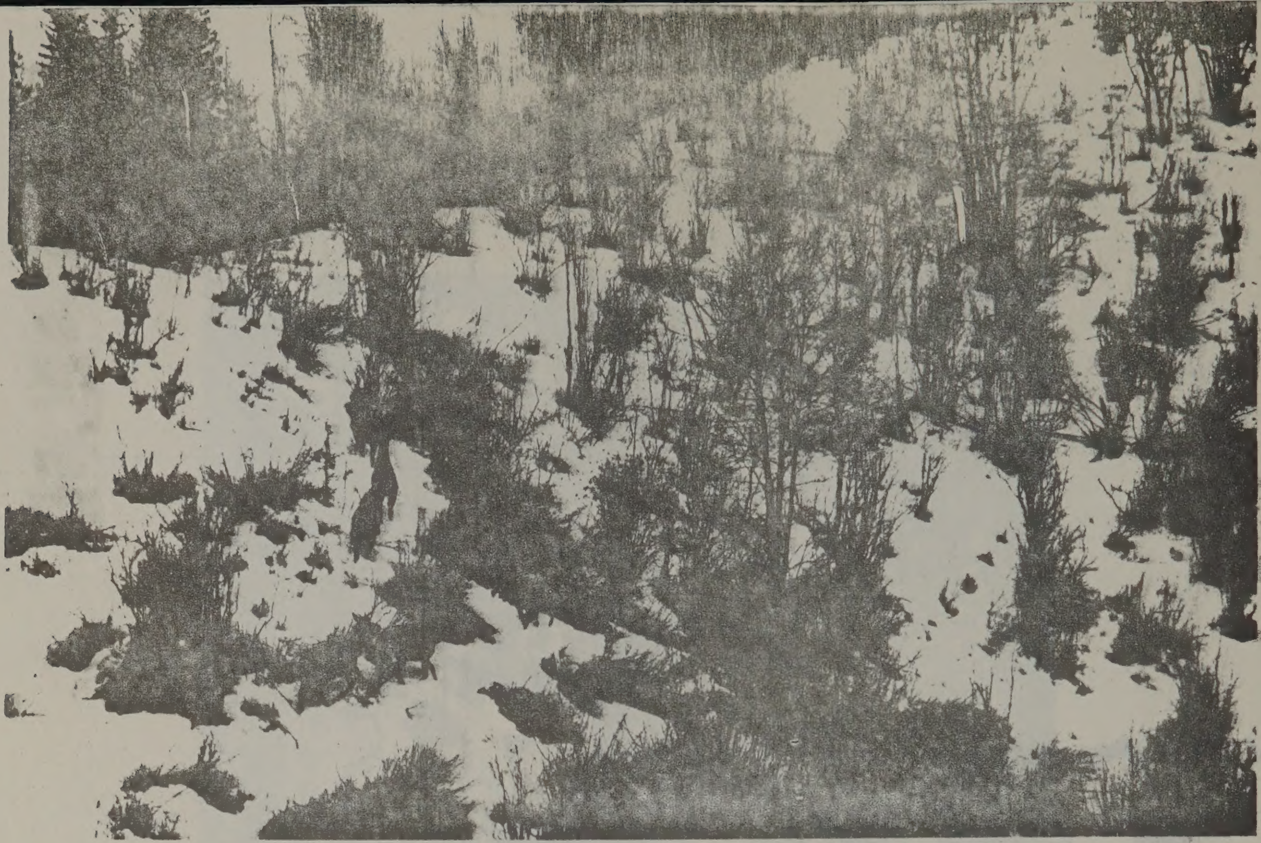


Fig. 25. Elk winter range along the Selway River. Under snow conditions, the animals depend almost entirely on the twigs that have grown during the past year.

Fig. 26. Prescribed burning on elk winter range to create new sprouting of shrubs and to improve the quality of forage and the carrying capacity. (Courtesy T. Leege)

be increased to a level at which the entire range can be managed according to the principle of prescribed burning and restored rapidly to its former carrying capacity within a period of five years. After restoration, each area should be burned approximately every five years to keep the sprouts within reach of the game animals.

Since bracken fern is the fuel that carries the fire, areas that can be burned are largely determined by the distribution of this plant. Bracken fern is distributed over about one-half of the Selway elk herd management unit. On the other half, light cutting of tall-growing shrubs may be necessary in order to create fuel. This treatment has not been tested; obviously it would cost several dollars per acre. Even at that, however, it should be a worthwhile expenditure of Forest Service funds.

The question arises as to whether certain winter ranges should be restored to timber or maintained in shrubs for big game. Economic analysis is not particularly useful here because big game have intangible values for hunters, hikers, photographers and Sunday drivers that are difficult to quantify. For example, during winter many people drive to the Selway River to see elk. How much is this worth to them?

It is recommended that the present winter ranges be maintained and managed primarily for big game. A few scattered conifers add scenic aspects to the watersheds, particularly in winter when the shrubs are bare of leaves. For this reason burning should be done in a way that will not destroy all conifers.

On summer ranges there is no particular deficiency of browse and forage. Much clear-cutting of timber takes place, followed by burning of slash (Fig. 27). The burning stimulates redstem ceanothus by cracking the seed coat, enabling the seed to imbibe water and germinate (Fig. 28). In forested areas this shrub has been shaded out for many years, but viable seeds are still there in the humus, and fire is essential for germination.

Should the slash be burned? The answer, of course, is "Yes." To get an even distribution of redstem ceanothus (Fig. 29), the slash should be spread as evenly as possible and burned. There is also opportunity to burn slash and improve browse after thinning operations (Figs. 30 and 31).

A portion of the Selway elk herd management unit is in the National Wild and Scenic Rivers System. One management objective is to protect and enhance fish and wildlife and aesthetic, scenic, historic, and other values that will contribute to public use and enjoyment of this free-flowing river and its immediate environment. Much debris has accumulated in portions of the area (Fig. 32). Piling and burning of the debris would safeguard the area against a destructive wildfire and at the same time improve the area for big game and other values.

(2) Alternatives

Other means of restoring game ranges have been tested, but nothing good has been discovered (38). Planting has been used as a means of

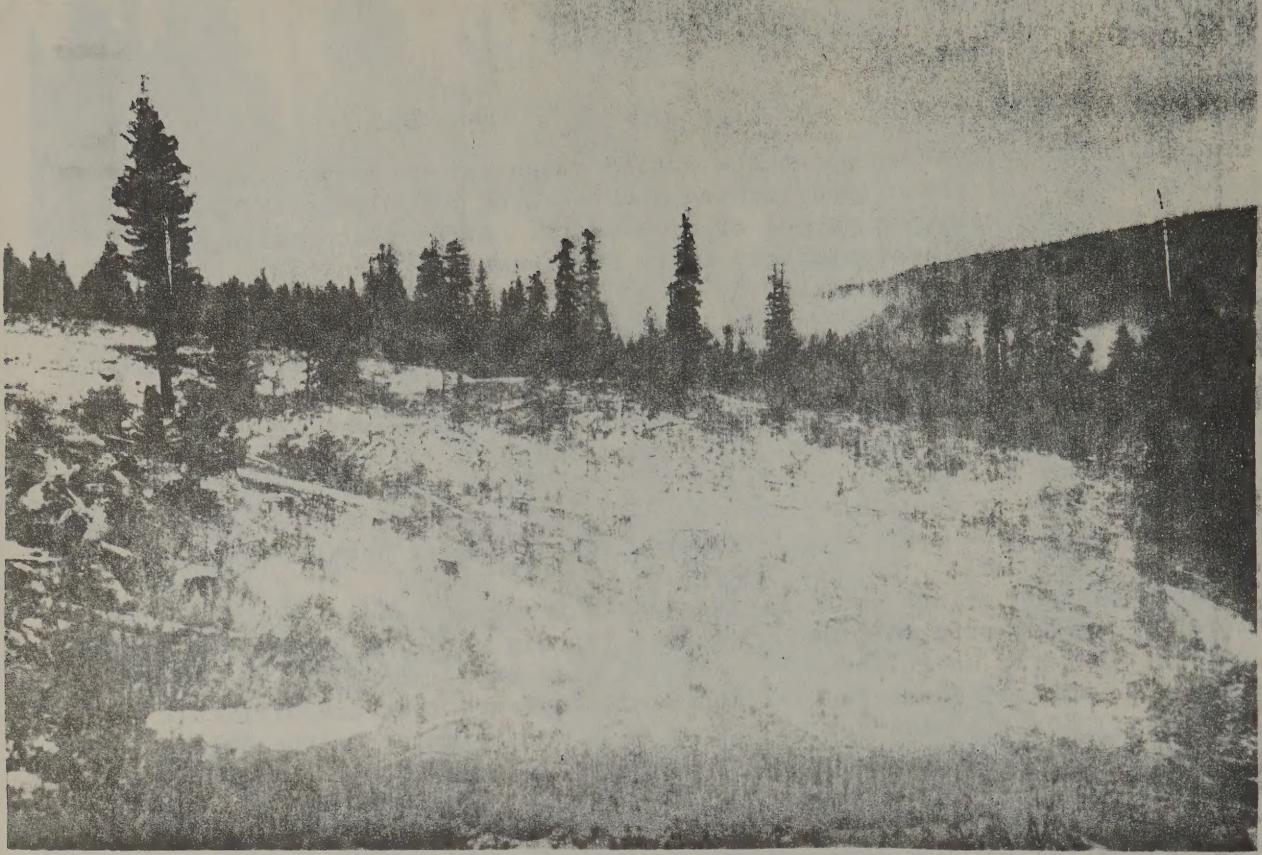


Fig. 27. Clear-cutting of timber in spots, followed by burning of slash, creates ideal browse conditions for elk.

Fig. 28. A dense stand of redstem ceanothus seedlings that started on a clear-cut area followed by burning of slash. The seeds need to be cracked by fire before they will germinate. (Courtesy T. Leege)

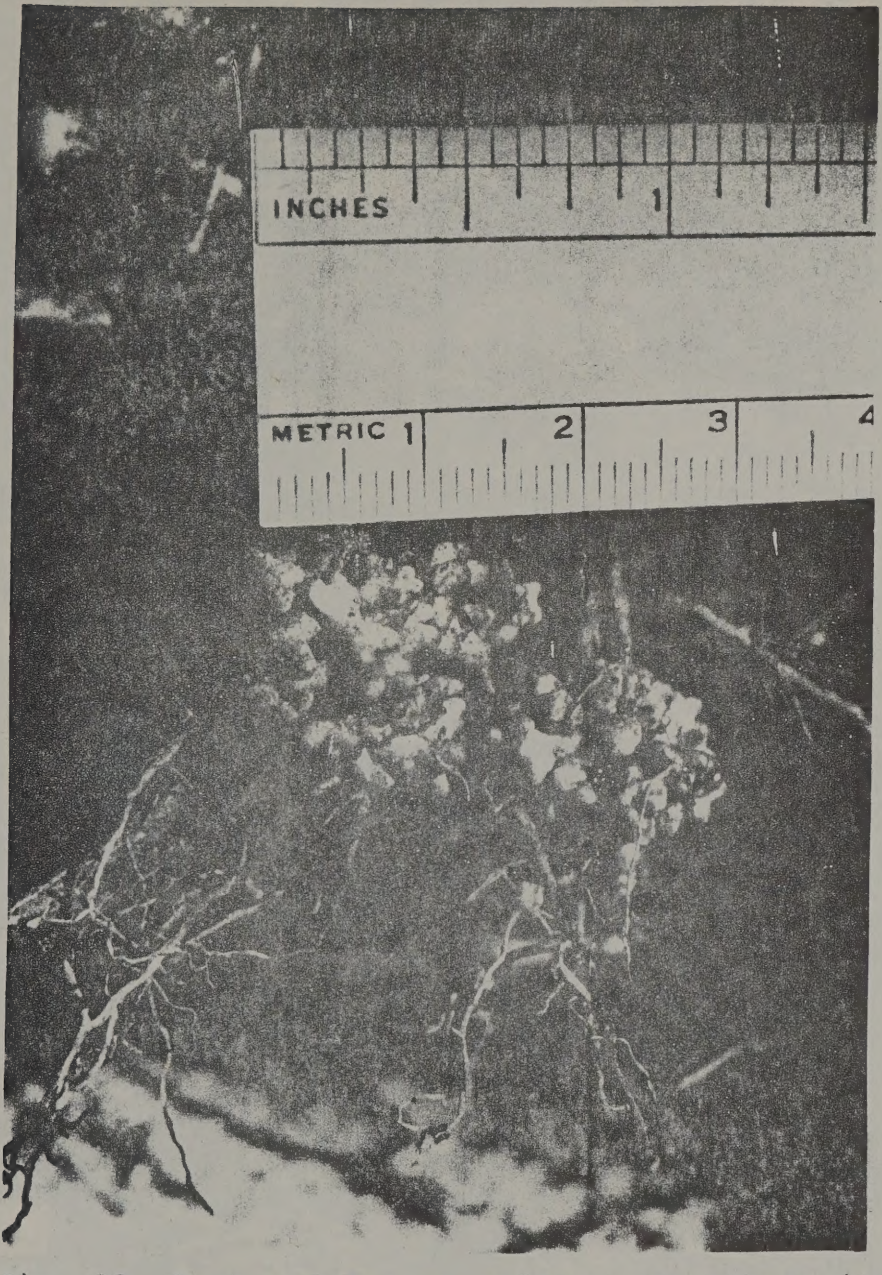


Fig. 29. Root nodules on redstem ceanothus with nitrogen-fixing bacteria are important in building up nitrogen in the soil and producing high-protein browse. (Courtesy T. Leege)

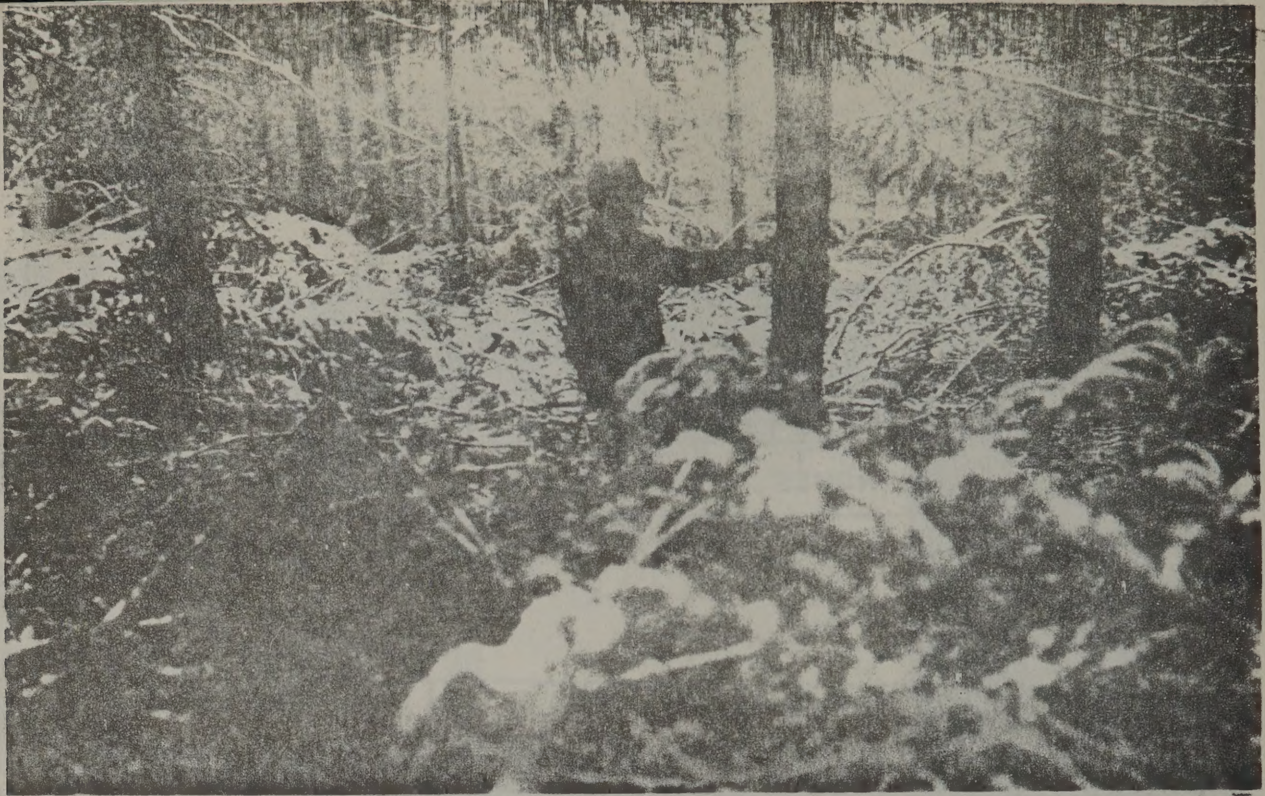


Fig. 30. A recently thinned area with an extreme fire hazard and poor conditions for big-game animals. If the materials had been piled or spread and burned as the thinning was done, the creation of fire hazards would have been avoided and the conditions for wildlife many times improved.

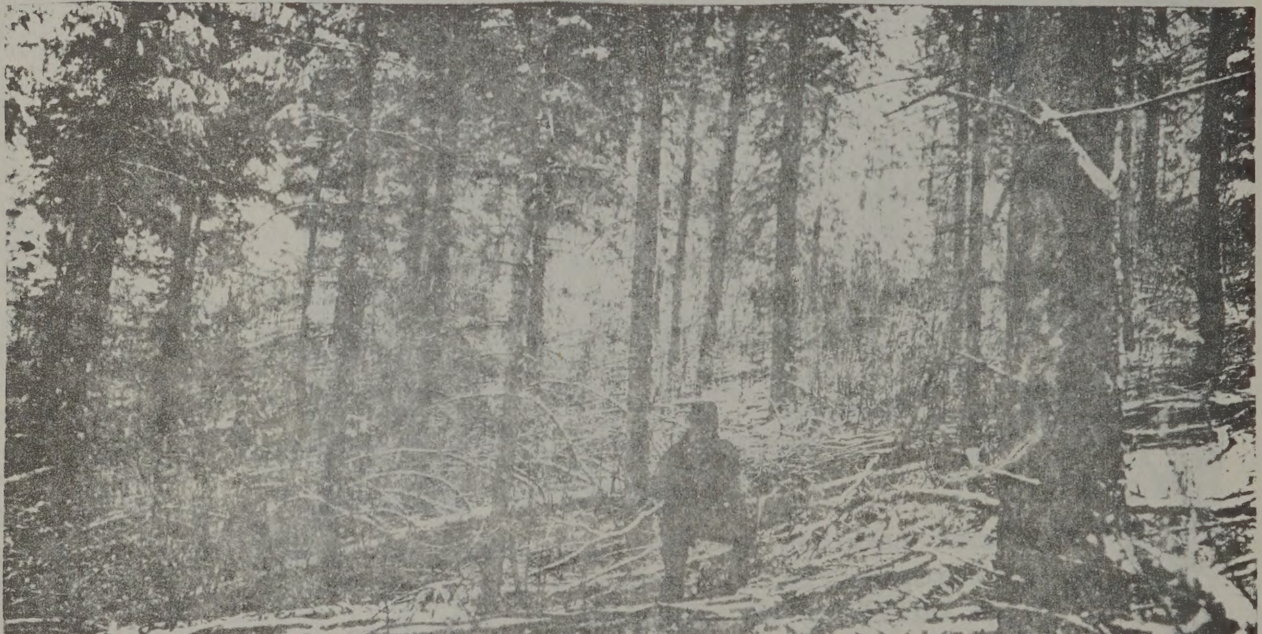


Fig. 31. Thinned several years earlier, the debris is still so deep that big-game animals can hardly get through to browse on the shrubs. There is no redstem ceanothus in this area where there was no fire.

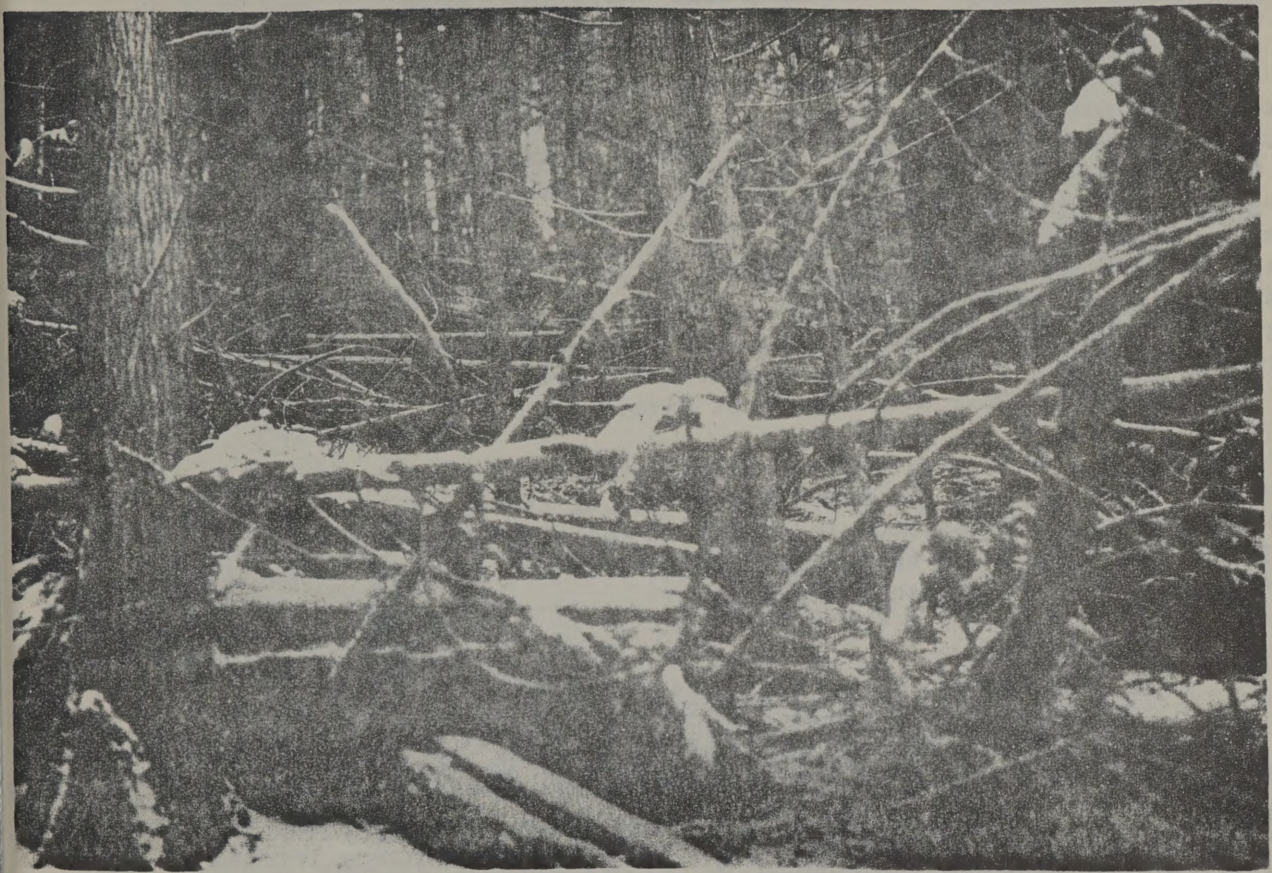


Fig. 32. Debris on the forested slopes along a portion of a national and scenic rivers system. The debris should be piled and burned to safeguard against wildfire and to improve the area for big game as well as other scenic values.

replacing dead shrubs (14) This is expensive and is not adaptable to steep slopes. A second method has been to reduce browsing pressure through heavier harvesting of game animals. Usually this method is ineffective unless the ranges are improved at the same time by some other means. Herbicides have been used to set back the tall-growing shrubs, but the redstem ceanothus is sensitive and is easily killed. Therefore prescribed burning is the only practical method of maintaining and improving the environment for elk and other big-game animals.

3. FIRE ECOLOGY ON THE BRUSHY BASIN WATERSHED

The brushy basin watershed is 8,000 acres of dense evergreen shrubs or chaparral on the Tonto National Forest in Arizona. Principal woody species are shrub liveoak, manzanitas, mountain laurel, desert ceanothus, and redberry (47). Most of these reproduce by sprouting; the remainder, by seeds that are conditioned by fire. After fire the plant cover normally returns to its former status in about 15 years. Since lightning fires are frequent, the brushy basin watershed has probably burned hundreds of times over the centuries. Each time it has returned to its original state. Some species of chaparral may depend entirely upon recurring fires for survival. They appear for a year or two after fire and then disappear until after the next fire.

The brushy basin watershed is fairly typical of the more fertile chaparral areas, perhaps the upper one-third, of the 4½ to 5 million acres of middle-elevation brushlands in Arizona. The slopes are moderate to steep, ranging from 10 to 60 percent. The soils are granitic. Precipitation is 15 to 20 inches annually.

a. Environmental Impact of Fire Suppression

Mature chaparral varies in volume from 30 to 60 tons per acre; its density generally makes it almost impenetrable to livestock and game animals (Fig. 33). When air temperatures are 100° F. or higher and the relative humidity is 15 percent or lower, wildfires can be very intense and difficult to suppress. Furthermore, human life is sometimes lost in fighting wildfires. Twenty-eight thousand acres of adjoining watersheds were burned by a single, intense, and difficult to control wildfire in 1959. Obviously, erosion was severe for awhile after the wildfire.

b. Origin of the Problem

The Forest Service had vigorously suppressed all fires on the watershed for many years, thus permitting growth of a mature and deteriorating brush cover. Under this condition, extreme wildfire hazards developed, and the watershed was of little multiple-use resource value.

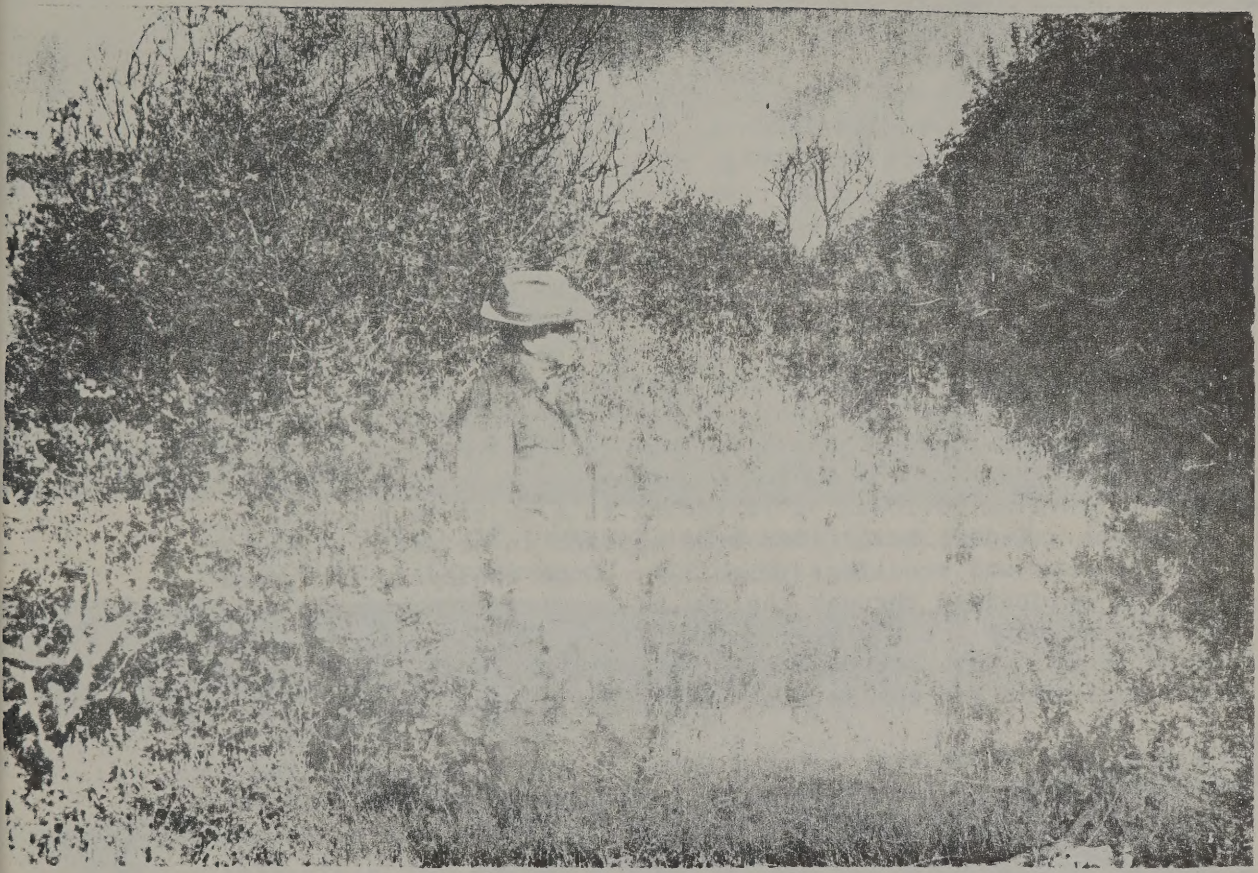


Fig. 33. Typical of natural chaparral on the brushy basin watershed, almost impenetrable to wildlife. Fire hazards are extremely high.

c. Environmental Considerations and Alternatives

(1) Considerations

After detailed studies on nearby watersheds over a seven-year period, the Forest Service prescribe-burned the brushy basin (Fig. 34) to reduce fire hazards and the costs and damages of wildfire conflagrations, to increase water yield, to provide browse and forage for livestock and wildlife, and to make the basin more accessible to recreationists by increasing the road and trail systems needed for intensive management (4,18,56).

The watershed was burned in three stages over a period of three years, about one-third each year (Fig. 35). Before fire was set, breaks were established and weather conditions were studied (54). The objective was to convert the heavy brush cover to grass in spots, leaving some brush for cover and for edge browsing, as well as for aesthetic value. The public was kept informed about all aspects of the program and the steps involved.

Fire will not kill chaparral but will only burn off the tops and cause new sprouts. Therefore other means of converting to grass and maintaining this cover were employed. Thus fire was used as a tool to accomplish only a part of the operation. In general the program consisted of prescribed burning followed by reseeding to a suitable perennial grass (Fig. 36). Later, herbicides were applied in selected places to kill brush sprouts and seedlings (Fig. 37). Once achieved, the grass areas will be maintained through the use of herbicides, or perhaps by prescribed burning every 5 to 10 years. The final decision awaits further testing and study. This work was done in cooperation with users of the Salt River watershed and the Arizona Fish and Wildlife Service.

Studies have shown that several benefits can be obtained from such treatment (18). Water yield from an adjoining watershed has been three times greater, following treatment, than from a nearby control watershed; or, in terms of flow volume, 8.2 inches compared with 2.6 (21,48,49). Streams once intermittent now flow throughout the year (62,63; Fig. 38). Habitat conditions for wildlife and livestock have been improved. The browse from edges of chaparral and forage from herbaceous plants, along with available water, have permitted greater numbers of deer and quail in the area, and livestock-carrying capacity has increased from 20 head per year to 200 (4). Also, the brushy basin has been used more by recreationists for camping and picnicking.

There can be no doubt that the wildfire problem on brushy basin watershed has been mitigated by prescribed burning and conversion to grass in spots. Numerous incidents have indicated that fires may start in treated areas as easily as in mature brush, but the wildfires are many times easier and safer to suppress (4). Another benefit has been the training of personnel in fire control on the Tonto National Forest.

In prescribed burning, smoke is kept at a minimum through fire-danger criteria incorporated in burning prescriptions (54). Specifically, wind

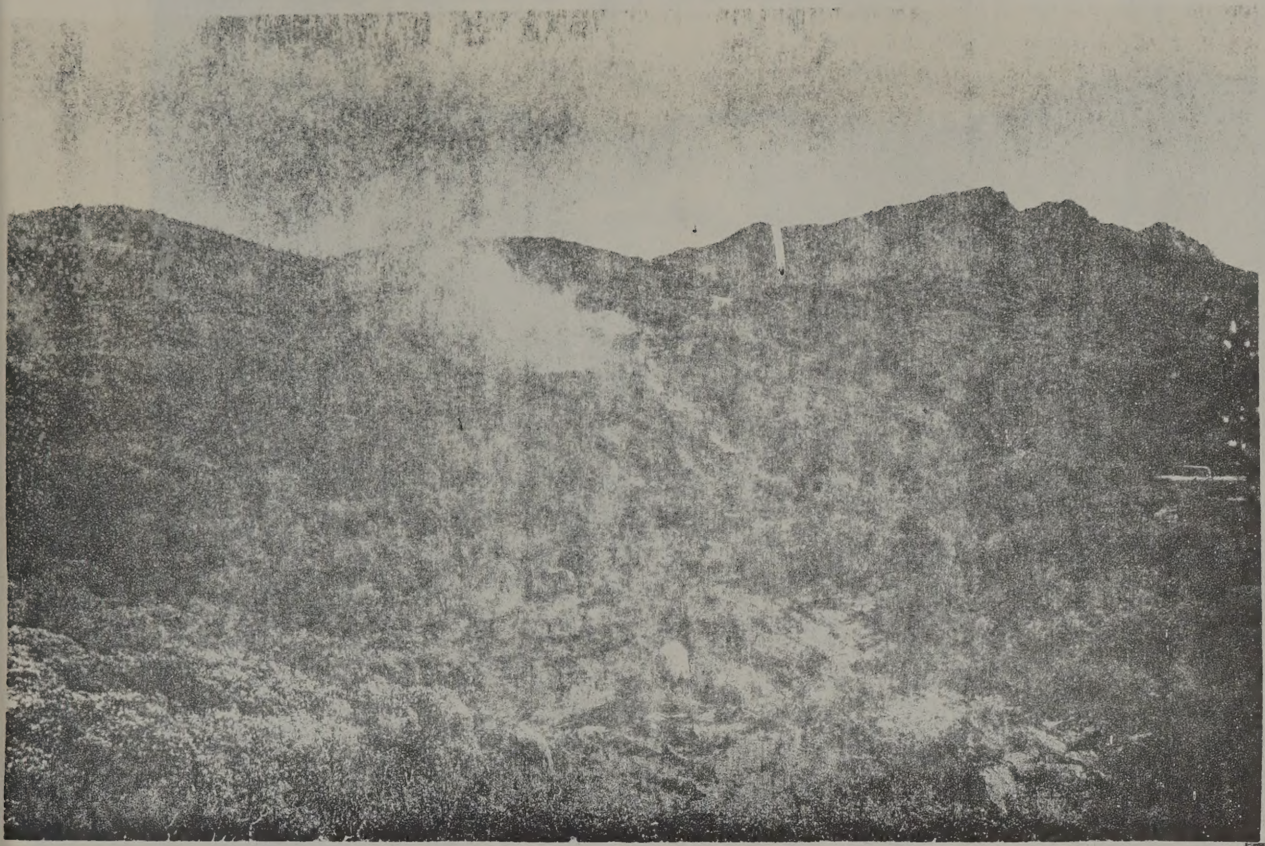


Fig. 34. The beginning of prescribed burning on brushy basin watershed. (Courtesy J. Baldwin)

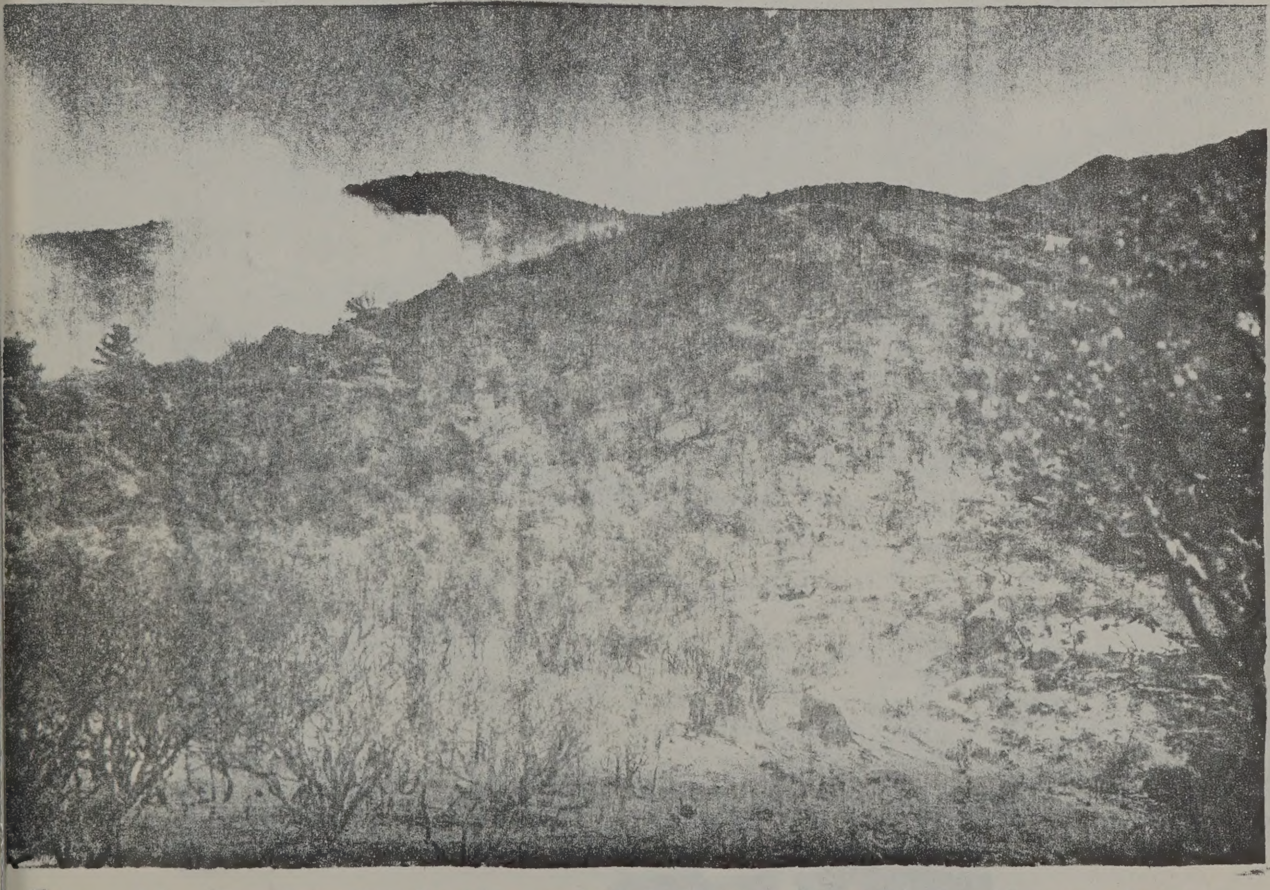


Fig. 35. The brushy basin watershed was burned in three stages over a period of three years. Photo shows the first stage nearing completion. (Courtesy J. Baldwin)

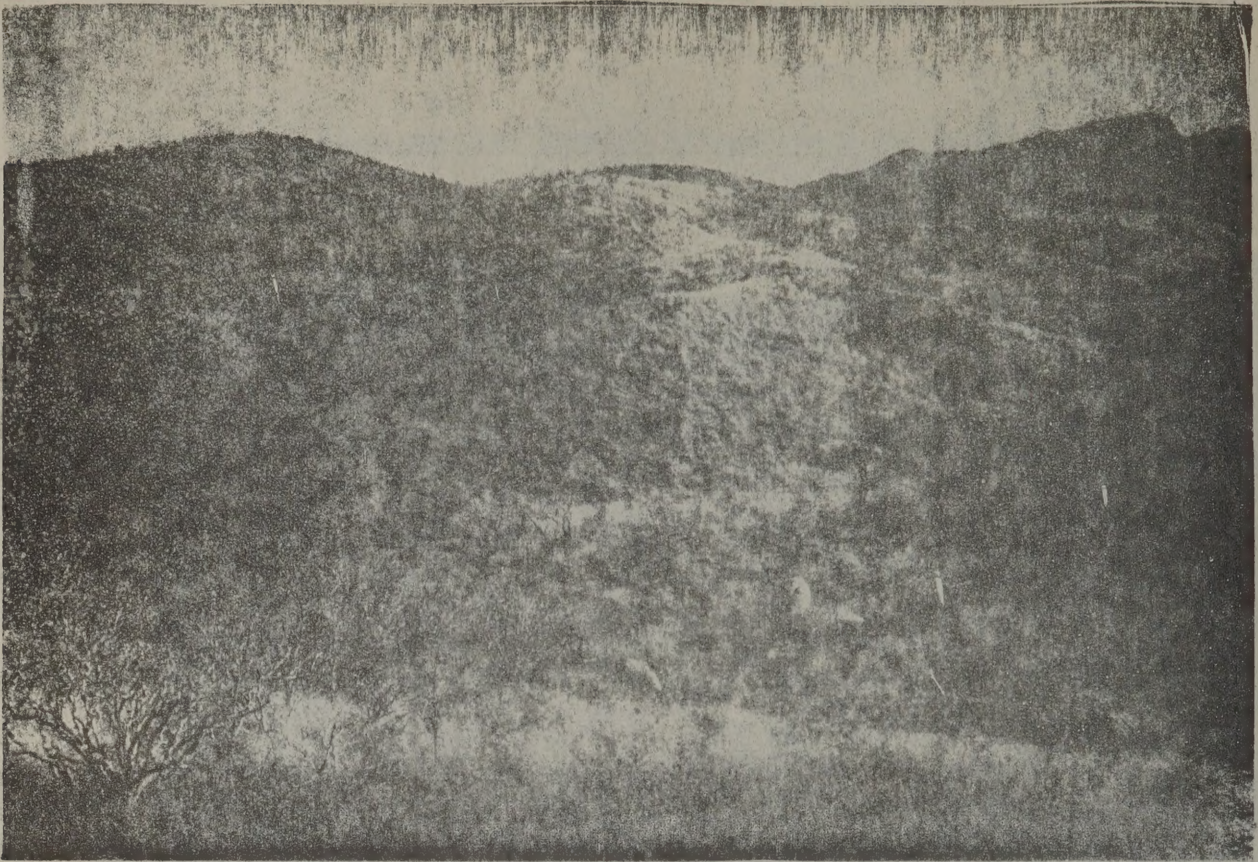
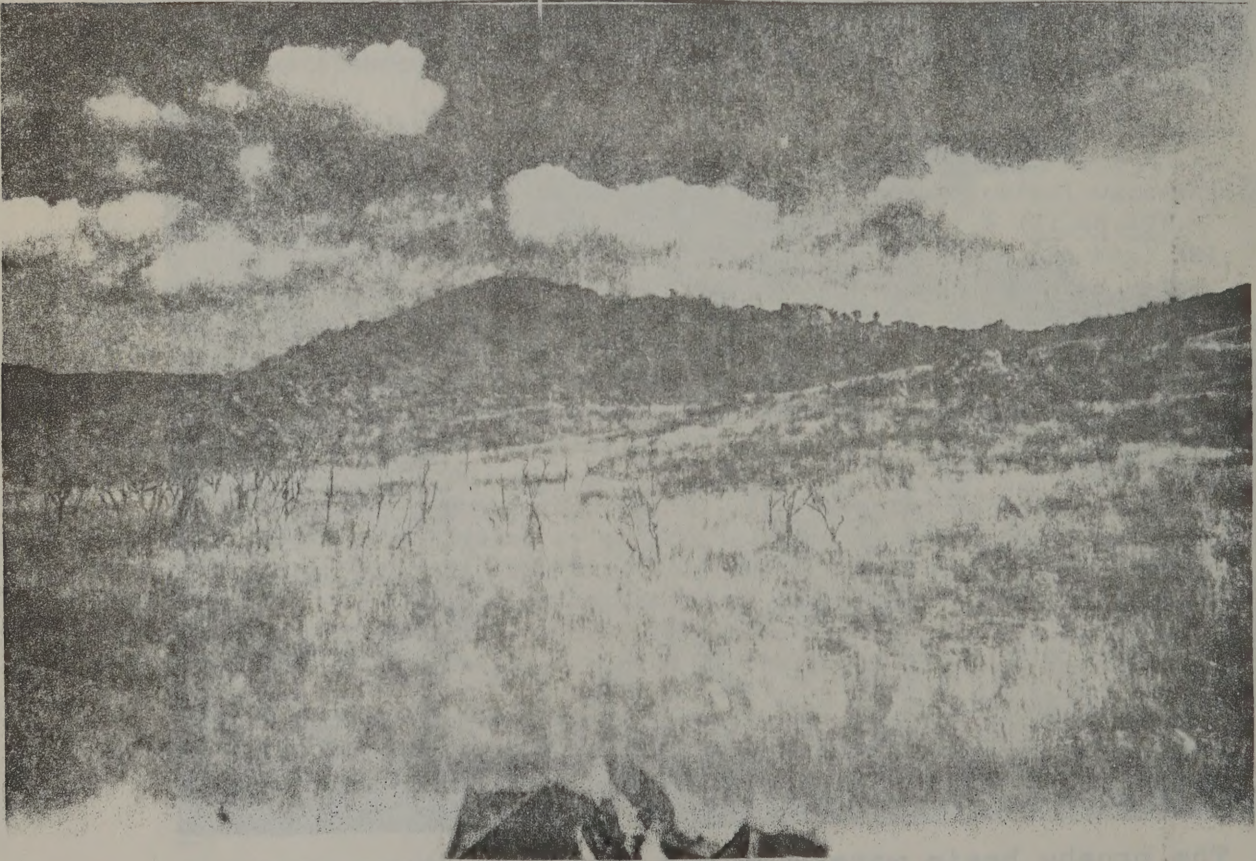


Fig. 36. Appearance of brushy basin watershed after prescribed burning and reseeding. Fire hazards are low and the wildlife habitat is ideal for cover and for forage and browse. (Courtesy of J. Baldwin)



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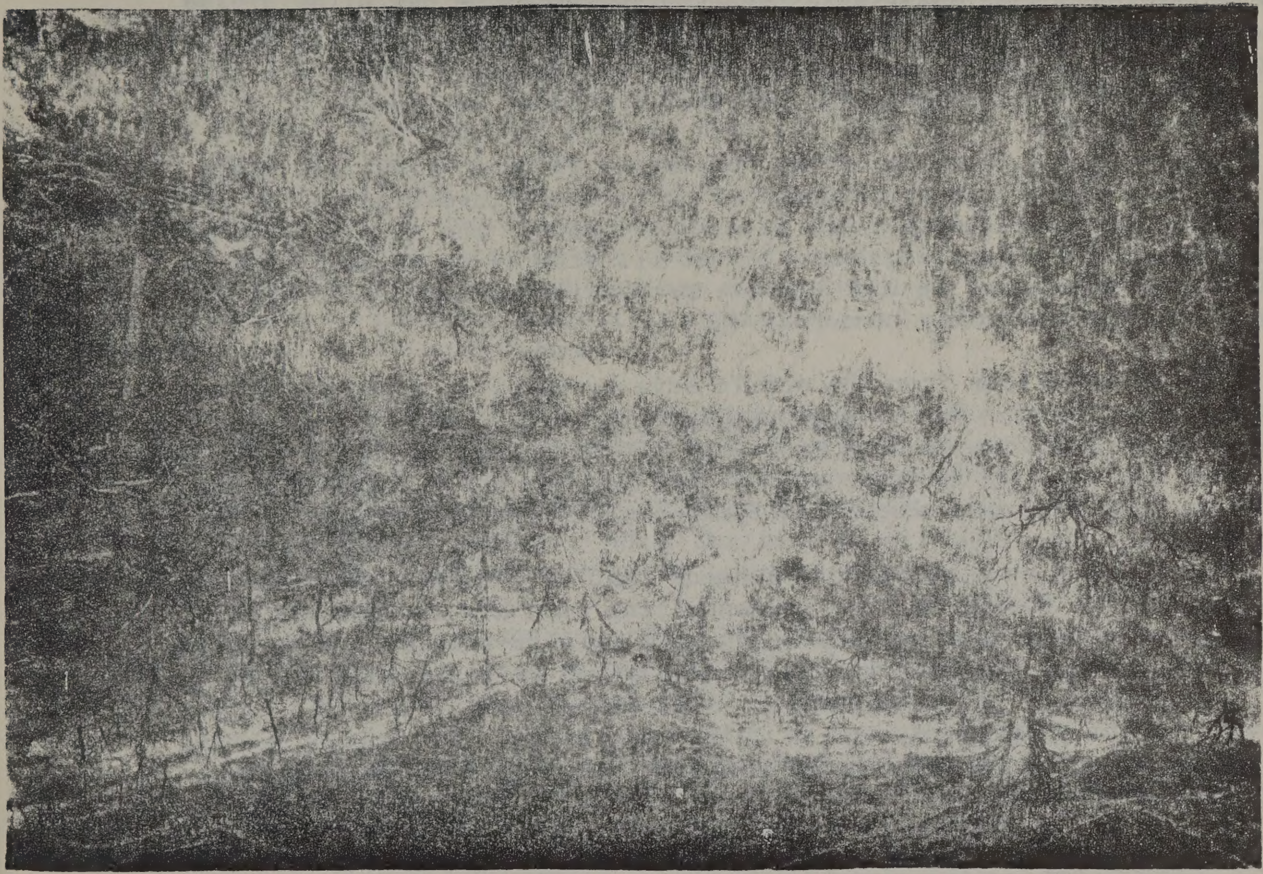

Fig. 38. Slightly accelerated erosion may follow prescribed burning, but the final, long-range result will be less erosion than beneath mature chaparral, especially following wildfire.

direction must be such that the smoke is carried away from populated areas; temperature inversions are avoided; and fires must be of sufficient intensity to create a conversion column that will carry the smoke aloft for dispersal. Prescribed burning in chaparral is favored for smoke dispersal because locations and elevations are generally well above populated areas and because of the high fire intensity associated with chaparral burning.

A problem has arisen as a result of using herbicides in lieu of prescribed burning in a project near Globe, Arizona. Since the watershed is near Globe, the Forest Service decided to kill the brush outright with the herbicide. Some drifting of the herbicide caused slight damage to plants on private lands outside the watershed. Some complaints were also made that the herbicide was polluting the area's water supply. A number of articles about the incident appeared in a local newspaper.

Immediately after receiving complaints in June, 1969, and again in the fall of 1969, special teams of specialists investigated the alleged herbicide damage to animals and to private lands. The Arizona Fish and Game Department reported no evidence of ill effects on animals, and the effects on vegetation on four private properties were minimal, and the vegetation was returning to normal (60).

Other questions from the public have surfaced as a result of the herbicide incident. In the Arizona Republic of October 19, 1969, a columnist stated that he does not agree with the program on the Tonto 100 percent, nor does he disagree with it 100 percent (3). Experience over a longer time will be valuable in fully evaluating the project.

In developing a position statement that will answer the questions that arise, the Forest Service is consulting with key individuals and groups, and public meetings are being held more frequently. At present, excessive fear by the general public of any use of herbicides may be partly responsible for the problem. Furthermore, the objectives and results of the program may not be fully understood. The Forest Service is taking measures to resolve the problems, and the results at present look promising.

(2) Alternatives

There are no alternatives to the procedures being carried out by the Forest Service if chaparral lands like those on brushy basin watershed are to be managed with tolerable fire hazards, and the multiple-use resources obtainable from such watersheds are to be realized. Fire and herbicides must be used together for conversions of the type described. For the economic use and enjoyment obtainable from chaparral brushlands, it is important that the Forest Service continue with the program underway on the brushy basin watershed.

4. DISCUSSION AND RECOMMENDATIONS

Based on the three study areas, it may be concluded that fire can be used among different vegetation types for a variety of reasons. In forested areas, the greatest beneficial use of fire will be for reduction of fuels so that wildfires are easier to suppress and are not so destructive. Closely interrelated with this will be the use of fire to restore natural ecological conditions in parks and other protected areas.

Before white man appeared on the scene, surface fires were frequent, and they functioned to maintain two fuel layers: one of green canopy above, and the other of pine needles and grasses and flowers on the ground. The 65-year-old policy of fire exclusion has encouraged the development of a solid fuel layer in many places, from the tops of the tallest trees to the young saplings and brush and litter on the ground. During those hot, dry, windy periods, this fuel condition promotes the large crown fires which in recent years have been nearly impossible to stop. The scene in Figure 10 illustrates the damage that can be done. Under these difficult conditions, fire fighters are doing the best job possible, but they appear to be battling against increasingly serious odds wherever the dangerous fuel build-up continues.

Prior to adoption of our present fire suppression policy, a ranger could go on horseback with his shovel and usually not have difficulty in extinguishing a fire. Little damage was ever done. But today, a fire in the same spot would probably require 20 to 100 men or more with bulldozers, airplanes, and tankers. When the fire is extinguished, the landscape will be badly scarred with great attendant damage.

The wildfire situation presents a dilemma. Nobody wants the crown fires, but they seem to occur anyway. What is the answer? Professor Mason (39) of the University of California suggested:

> In the long run, the cheapest method will be to maintain a forest in low-fire-hazard condition through controlled burning at intervals that will prevent the fire hazard from building up. . . . Nature before us successfully managed the forest with her own system of controlled burning. As fire seems inevitable in an arid climate, would not the wisest course be to see that fire occurs only at such times and in such places as we choose? Under such circumstances the fire would no longer present a threat to our forests.

This system has been thoroughly tested by Biswell (7), Weaver (65,67) and others; the results appear excellent. Such fires are not only beneficial in reducing fuels and easing the wildfire problem, but the understory vegetation, useful to wildlife and for aesthetics, is encouraged and the trees are healthier because they have more water and less competition. Under these conditions, tree losses from insects appear to be fewer.

Why is it that the public land agencies have been so slow in seeing the ill effects of complete fire exclusion and the possible good effects of prescribed burning? This is a difficult question. For many years the Forest Service pushed the policy of fire exclusion to the point where neither research nor testing was done in the Western United States. Furthermore, it was not wise for a young forester even to mention the idea of use of fire.

It is wise to do a great deal of research and testing before adopting a new policy. This entails working out all of the interrelationships that might be involved. In this particular case, the fire exclusion policy was adopted after very meager research.

The National Park Service has started a prescribed burning program, recognizing that fire is one of the ecological factors contributing to the welfare of plants and animals native to a given habitat. During the past year, some 5,000 to 6,000 acres were burned, mostly in Kings Canyon National Park. At the present time, this Park, Sequoia, and Yosemite Parks plan to prescribe-burn about 600,000 acres over a 10- to 25-year period. This work has come rather late, since there will probably be some very big and destructive wildfires in these parks over the next several years. One has only to look at fuels to reach this conclusion.

In recent years the Forest Service has been burning a great deal of slash after clear-cutting in those forest areas that require this pattern of cutting. This is different from burning under a canopy of trees. Burning of slash after clear-cutting is a good practice, but the Forest Service should give more attention to prescribed burning under a canopy of trees and learn how this fits into efficient land management practices.

Prescribed burning does create another environmental problem, namely, wood smoke contributing to smog. No one wants smoke and smog, but which is the greater evil: wood smoke contributing in a small way to the smog problem, or the wildfire that burns down a debris-polluted forest, followed by severe flooding and soil erosion? Certainly a little smoke from prescribed burning is preferable to a lot of smoke from a wildfire and the erosion that follows.

In light of the three case studies and the discussion, the following are recommended:

1. That the National Park Service be appropriated the necessary funds to proceed in reducing wildfire hazards, and in restoring natural conditions, over the lands under its jurisdiction. In the three National Parks -- Kings Canyon, Sequoia, and Yosemite -- the acreage is about 600,000 and the cost would be about $60 million ($500,000 per year) for a 10- to 25-year period. This work should be financed and carried out as rapidly as possible. This type of work should also be extended to other National Parks.

2. The National Park Service as well as the Forest Service should do more research of the interrelationships involved, including smoke produced, from prescribed burning in the understory of trees. The Park Service is already doing some good research, but this activity should be increased by at least $50,000 to $100,000 per year over the next 10 years to evaluate fully the work that is being done.

These are important activities and are essential if our parks and wildlands are going to be preserved and managed for the greatest good of all the people.

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